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<tr><td colspan="2">REVISED IDENTIFICATION OF CONSTITUENTS OF POTENTIAL CONCERN AND EXPOSURE ASSESSMENT WORK PLAN
HUMAN HEALTH BASELINE RISK ASSESSMENT TECHNICAL MEMORANDUM
LCP CHEMICALS SITE, BRUNSWICK GEORGIA
OPERABLE UNIT 2</td></tr>
<tr><td>Date:</td><td>March 23, 2021</td></tr>
<tr><td>To:</td><td>Mr. Robert Pope, U.S. EPA Region IV, Superfund Senior Remedial Project Manager</td></tr>
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Executive Summary

This technical memorandum was prepared by Environmental Planning Specialists, Inc. ("EPS") (dba: Montrose Environmental Solutions ("Montrose")) on behalf of LCP Steering Committee and presents the initial elements in the development of the Human Health Baseline Risk Assessment ("HHBRA") for LCP Chemicals Operable Unit ("OU") 2, namely the identification of Constituent of Potential Concern ("COPC") and the Exposure Assessment Work Plan, which will form the basis for the computational risk assessment. OU2 addresses groundwater beneath the LCP Site and includes the subsurface within the former chlor-alkali cell building area ("CBA"). COPCs were developed according to standard methods that are inherently conservative, such that potentially important contributors to risk are carried forward into the HHBRA.

The Exposure Assessment Work Plan considers practical aspects of the site setting along with current and anticipated future uses of the property, consistent with recognized property use constraints in United States Environmental Protection Agency's ("EPA's") determination of the Record of Decision ("ROD") for Operable Unit 3 (upland soils) recently concluded (EPA, 2020a).

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ACRONYMS AND ABBREVIATIONS

ADD	Average Daily Dose
AOC	Administrative Order by Consent
Arco	Atlantic Richfield Company
BERA	Baseline Ecological Risk Assessment
CBA	Chlor-alkali Cell Building Area
CBASI	Cell Building Area Subsurface Investigation
CBP	Caustic Brine Pool
COC	Constituent of Concern
COPC	Constituent of Potential Concern
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
D1	Depth 1 – start of sample depth interval in ft-bgs
D2	Depth 2 – end of sample depth interval in ft-bgs
ELCR	Excess Lifetime Cancer Risk
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
EPS	Environmental Planning Specialists, Inc.
ELCR	Excess Lifetime Cancer Risk
EU	Exposure Unit
FS	Feasibility Study
FI	Fraction Ingested
Fm	Formation
ft-bgs	Feet Below Ground Surface
HHBRA	Human Health Baseline Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
LADD	Lifetime Average Daily Dose
Mbr	Member
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
RI	Remedial Investigation
RP	Responsible Party
ROD	Record of Decision
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
TM	Technical Memorandum
UCL	Upper Confidence Limit
VISL	Vapor Intrusion Screening Level

1 INTRODUCTION

This Technical Memorandum ("TM") was prepared by EPS, dba Montrose Environmental Solutions (Montrose)) on behalf of the LCP Steering Committee represented by Honeywell and the Atlantic Richfield Company ("Arco"), Responsible Parties ("RPs") to an Administrative Order by Consent ("AOC") EPA Docket No.: 95-17-C for the LCP Chemical Site Superfund Site located at 4125 Ross Road, Brunswick, Glynn County, Georgia (the "Site"). This TM addresses the early components of the HHBRA for OU2, which comprises the Site-wide groundwater and the subsurface of the CBA.

OU2 characterization studies and monitoring have occurred under the AOC dating back to 1994. A *Site Characterization Summary Report* providing a comprehensive summary of these investigations was submitted to the agencies in July 2020 (EPS 2020), and was subsequently approved by the EPA on August 14, 2020. As an outcome of this process, a final round of focused groundwater monitoring was performed in August 2020 in support of the upcoming Remedial Investigation ("RI") Report. The results of the August 2020 groundwater monitoring event are included in the current COPC screening.

The soils overlaying the Site-wide groundwater but excluding the CBA footprint were addressed as OU3. A HHBRA and Baseline Ecological Risk Assessment ("BERA") were conducted for OU3. The OU3 HHBRA (EPS, 2012) included five exposure units ("EUs") and evaluated four human receptors: Commercial/Industrial Worker, Excavation Worker, Trespasser, and Hypothetical Resident. The Excess Lifetime Cancer Risk ("ELCR") and Hazard Index ("HI") computed for most receptors were within or below the EPA's acceptable ranges (ELCR from 10^{-6} to 10^{-4} or HI of unity). One exception was the Excavation Worker, which had an HI of 2 (nominally above the EPA's preferred value of unity) in one of the EUs. The other exception was the Hypothetical Resident, which had an HI between 4 and 15 for three of the EUs and an excess lifetime cancer risk ("ELCR") of 10^{-4} in one EU. The constituents that were the principal risk drivers were Polychlorinated Biphenyl ("PCB")-Aroclors, Polycyclic Aromatic Hydrocarbons ("PAH"), and mercury.

The results of the BERA for OU3 are not pertinent as an ecological risk assessment is not warranted for OU2. There is no reasonable ecological exposure to the groundwater condition and as for the CBA, the area is covered with clean fill soil to a thickness precluding ecological exposure.

The HHBRA will be based upon the process presented in EPA Region 4 Guidance (EPA, 2018) drawing upon Site-specific elements as approved in the OU3 HHBRA (EPS, 2012). The HHBRA process includes the following elements:

- Data Collection and Evaluation including identifying COPCs;
- Exposure Assessment including identification of receptors and exposure factors;
- Toxicity Assessment including presentation of toxicity values;

- Risk Characterization including quantifying ELCRs and Hazard Index(es) ("HIs") to receptors;
- Identifying Constituents of Concern ("COCs") based on specific risk levels; and
- Developing Site-specific remedial goals.

This TM delivers the results of the Data Collection and Evaluation and part of the Exposure Assessment. The Data Collection and Evaluation includes defining the data (Site-wide groundwater and CBA soil) to be included in the HHBRA report and identification of COPCs derived from screening of the data. An Exposure Assessment includes three elements: characterization of the exposure setting, identification of exposure pathways, and quantification of exposure. This TM provides the results of the first two elements (including presentation of Conceptual Site Models ("CSM") for groundwater and soil, and exposure factors to be used for each receptor and pathway), which provides the frame work for quantification of exposure that will be included in the HHBRA report.

2 BACKGROUND

2.1 Site Setting

The original Site property occupied approximately 813 acres immediately northwest of the City of Brunswick, Glynn County, Georgia. Tidal marshland comprises about 670+ acres of the original property. The primary upland area, where manufacturing operations at the LCP facility occurred, is located on 133.5 acres of upland area, east of the marsh and bordered by county operations to the north, Ross Road to the east, the Turtle River and associated marshes to the west, and Brunswick Cellulose to the south (Figure 1). Additional information regarding past manufacturing operations will be included in the RI Report (the HHBRA will be a chapter of this report).

2.2 Operational History and Key Features Regarding OU2

2.2.1 Refinery and Power Generation Operations

Arco operated the Site as a petroleum refinery from 1919 to the early 1930s. At one time, over 100 process and storage tanks were present on the Arco facility with operations spanning much of the Site (see refinery layout line feature, Figure 2). The refinery was fueled by coal until 1922, after which oil was used as the primary fuel for the Arco operations. The refinery ceased operations by 1935. Concrete tank supports and numerous slab foundations from this time period currently remain at the Site.

Georgia Power purchased portions of the Site in 1937, 1942, and 1950. These purchases included two parcels of land and two 750 kilowatt electric generators from Arco. Georgia Power subsequently added an additional 4.0 megawatts of electric generation capacity to their operations at the Site. Bunker C oil was used as the fuel source for the power plant. Power plant operations were generally centered on the upland portion of the Site.

Historical refinery operations spanned the upland portion of the property. Areas of the operation by Arco and Georgia Power that reasonably contributed to the groundwater conditions include a northern and southern segment of the former Brunswick-Altamaha Canal that once traversed the western uplands margin where petroleum sludge was placed, API Separators also placed in a northern and southern segment of the former canal, and a Bunker "C" Tank Farm (Figure 2). Sludge and soil contamination associated with these features were addressed (removed) during the 1994-97 uplands removal response action. Much of the Site is also characterized by a residual petroleum hydrocarbon smear zone, the weathered remnants of petroleum products released across portions of the upland during this time period of operations.

2.2.2 Paint Manufacturing

The Dixie Paint and Varnish Company operated a paint and varnish manufacturing facility at the Site from 1941 to 1955 on a portion of the property south of the Georgia Power parcel. No information exists on the process operations and practices of the paint and varnish manufacturing facility other than the facility's location.

Disposal of coatings products (*i.e.,* paint) was inferred from the nature of the soil and waste removed from the Former Facility Disposal Area (Figure 2) during the 1994-1997 uplands soil removal action. Thus, the disposal of coatings products is an unknown but a probable contributing factor to Site soil and groundwater.

2.2.3 Chlor-alkali (Mercury Cell Process) Manufacturing

In 1955, after acquiring almost all the land constituting what is now known to be the Site, Allied Chemical and Dye Corporation (predecessor to Honeywell) established and operated a chlor-alkali facility on a portion of the Site, principally for the production of caustic solution, chlorine gas, and hydrogen gas. The chlor-alkali facility operated using the mercury cell process, which involved passing a concentrated brine solution between stationary graphite or metal anode and a flowing mercury cathode to produce chlorine gas, sodium hydroxide (the caustic solution), and hydrogen gas, as a by-product. Sodium hypochlorite (bleach) was also produced in a secondary reaction.

LCP Chemicals, Inc. purchased the property and the chlor-alkali plant from Allied in 1979. The chlor-alkali process continued with modification following the purchase by LCP. Part of the modification included the production of hydrochloric acid by reacting chlorine and hydrogen. Manufacturing operations continued while LCP was in bankruptcy until LCP's corporate headquarters began an orderly shutdown of the plant on February 1, 1994. The State revoked the facility's permit on February 2, 1994, essentially ending the facility's operations.

The former chlor-alkali manufacturing operation was centered south of B-Street which bisects the property entering from Ross Road. Two sister buildings at this location designated Cell Building 1 (north building) and Cell Building 2 (south building) each contained an independent mercury cell process supported by a salt purification plant and additional on-Site holding tanks for process liquids. Sodium hydroxide or caustic was the primary chemical product in the chlor-alkali process. In the chlor-alkali process, the caustic is produced in an electrolytic process with liquid mercury serving as the cathode. Historical release of mercury is attributed to the loss of liquid mercury during system operation (*i.e.,* leaks and spills) and to a lesser extent as dissolved mercury in caustic releases. Leaks and spills also occurred for liquid caustic (NaOH), sodium chloride brine, and bleach.

The chlor-alkali operations were supported by several on-Site lagoons or impoundments for manufacturing waste process liquids. The waste process liquids were slurried to impoundments and included lime softening muds, bleach muds, brine muds, and raw-brine solids. These impoundments predate current regulations (i.e., the impoundments were unlined) and included linear sections of the former canal (Figure 2).

2.3 Site Geology

2.3.1 Surficial Zone (Pliocene to Upper Miocene Formations)

The uppermost portion of the sedimentary deposits underlying the Site is comprised of the Satilla Formation ("Fm"), which is Holocene to Upper Miocene in age. The Satilla Fm is underlain by the Ebenezer Fm (previously referenced as the Coosawhatchie Fm), which is middle Miocene in age. The Ebenezer Fm replaced the Coosawhatchie designation in recent reporting of Georgia Geological Survey Information Circulars, publications by the U.S. Geological Survey, and reporting by engineering consultants (Steele and McDowell, 1998; Leeth, 1999; Weems and Edwards, 2001; Gill, 2001; Radtke, 2001; Clarke, 2003; Cherry et al., 2011; Gill et al., 2011).

The Satilla Fm is perched atop a variably-cemented sandstone layer (Ebenezer Member ("Mbr") #5) present at approximately 50 feet below ground surface ("ft-bgs"). The Satilla Fm is characterized by two vertically stacked members with distinct lithology. The upper Satilla is a well-sorted sand that gradually and cyclically coarsens from very-fine to medium grain size with depth. Discontinuous thin beds and laminations of silty clay are present in some places in the upper Satilla Fm. The upper Satilla ranges in thickness from 30 to 40 ft over most of the Site but becomes thinner in regions near the marsh edge. The lower Satilla member is a complex, very dense lithologic sequence with considerable lateral and vertical variability. Lithologies range from massive, high plasticity clay to silty clayey sands to well-sorted coarse sand with shells. The lower Satilla member varies irregularly in thickness, ranging from around 12 to 14 ft thick in the northeastern part of the Site to around 2 to 4 ft thick in the southeastern part of the Site. The lower Satilla is characterized by notably denser sediments serving as a semi-confining layer where present. The Satilla Fm is monitored by the network of 'A', 'B', and 'C' monitoring wells.

The top of the Ebenezer Fm is identified by a variably-cemented sandstone layer (Ebenezer Mbr #5) encountered at a depth of approximately 50 ft-bgs. The sandstone is strongly to weakly cemented and contains a matrix of silica, dolomite, and phosphate cements. The layer acts hydraulically as a semi-confining unit. The water-bearing zone underlying the cemented sandstone layer (Ebenezer Mbrs #4/#3) consists primarily of medium gray sand with lesser amounts of greenish-gray silt. The sand is typically fine to medium-grained, slightly silty, and well sorted. The total thickness of the #4/#3 Mbr ranges from approximately 34 to 61 ft. This zone is monitored by the network of 'D' vertical monitoring wells and the 'HW' horizontal monitoring wells on the Site.

A marlstone (fuller's earth) confining layer comprises Ebenezer Mbr #2, at a depth of approximately 100 ft-bgs and is approximately 30-ft thick (described in the original OU2 RI Report (GeoSyntec Consultants, 1997) as the Coosawhatchie C unit). The Ebenezer Mbr #1 water-bearing zone (approximately 50-ft thick) is the lowermost portion of the Surficial Aquifer, known as the "Rock Aquifer" and is a water supply source for domestic households within the county where public water is not served. The Rock Aquifer occurs at a depth of approximately 130 ft to 175 ft below land surface.

2.3.2 Deep Zone (Middle to Lower Miocene Formations)

At the base of the Ebenezer Fm is the Berryville Clay Fm, a regional confining layer that protects the Upper Brunswick Aquifer. The Berryville Clay is about 80 ft thick and occurs at a depth of approximately 175 ft to 255 ft. The Upper and Lower Brunswick Aquifers, which lie beneath the Berryville Clay, occur within the lower part of the Miocene Formations. The Brunswick Aquifers comprise of multiple layers of confining beds and permeable water-bearing zones, and the confining layers generally consist of silty, montmorillonitic clay and dense phosphatic limestone, dolomite, and marlstone. The Brunswick aquifer system spans a depth interval of approximately 255 to 500 ft below land surface.

The deepest formation of regional interest is the Floridan aquifer system. The Upper Floridan aquifer is the most prolific aquifer system in the Brunswick area and occurs in the extremely porous Ocala limestone. The limestone is found at depth of between 500 and 1,500 ft below land surface. The Floridan aquifer is generally under artesian head and provides well yields in the range of 5,000 to 10,000 gallons per minute.

3 COPC EVALUATION

3.1 Exposure Units

3.1.1 Groundwater

For the purpose of the OU2 HHBRA, the Site-wide groundwater will be evaluated as multiple EUs. The EUs are vertically defined as shallow groundwater in the Satilla Fm and groundwater in the underlying Ebenezer Fm. Laterally, each exposure unit will encompass the entirety of the available Site-wide monitoring well network including wells installed in the marsh west of the uplands. In this manner, all wells will factor into the screening and no COPC will be eliminated. The well network for each groundwater EU is provided on Figure 3A and Figure 3B.

3.1.2 CBA Subsurface

For the purpose of the OU2 HHBRA, the soil in the CBA will be evaluated as one EU that encompasses the area in and around the CBA that was excluded from the OU3 HHBRA. The majority of the soil cover area of the CBA is currently partitioned as a fenced unit within the Site. The CBA EU is shown on Figure 4 and is approximately 6 acres.

3.2 Data Overview and Use

3.2.1 Groundwater

Groundwater at the Site has been characterized and monitored for 25 years. Various activities have occurred to prevent further release of contaminants to groundwater, to remove sources, and to treat areas impacted by caustic release where an elevated groundwater pH condition prevailed. The most recent fully comprehensive Site-wide groundwater monitoring event occurred in the fall of 2017. Subsequent focused monitoring events have occurred in 2018, 2019, and most recently August 2020. The scope and scale of the most recent groundwater sampling events (being utilized in the risk assessment process) is as follows:

2017

- Site-wide event conducted in the fall of 2017 involving all Site monitoring wells with full suite analytical testing, following conclusion of the caustic brine pool (CBP) Phase I-III CO_2 treatments spanning the period of 2013-2016
- Scope follows *Work Plan for Comprehensive Groundwater Sampling – 2017 (Operable Unit 2)* dated July 14, 2017 (EPS, 2017)

2018

- Comprehensive event involving 74 monitoring wells within and down-gradient of the CBP with full suite analytical testing (scope also involved deep soil borings in the CBA for observational and laboratory testing of soil cores)
- Initiated 2-year semi-annual monitoring program (select metals) for the 'D' and 'HW' wells in the Ebenezer Fm
- Scope followed *Site Characterization Work Plan for Operable Unit 2: Groundwater and Cell Building Area* revision 2 dated August 21, 2018 (EPS, 2018)

2019

- Focused event in and around the CBA including two new well clusters (MW-361A/B and MW-362A/B) with focused analytical testing (metals and other indicator parameters)
- Scope followed *Technical Memorandum, Technical Approach for Phase 4 of CO2 Sparging (Cell Building Area)* dated February 11, 2019 (Mutch Associates, 2019)

2020

- Comprehensive event involving 74 monitoring wells within and down-gradient of the CBP with full suite analytical testing (scope also involved deep soil borings in the CBA for observational and laboratory testing of soil cores)
- Concluded semi-annual monitoring program for 'D' and 'HW' wells
- Scope followed response to comments letter to the EPA under subject *Response to EPA Review, dated July 9, 2020 for the Site Characterization Summary Report Operable Unit 2 (OU2) Site-wide Groundwater and Cell Building Area,* dated July 20, 2020 (EPS, 2020b).

Guidance contends that the intent of a risk evaluation is to determine the potential risks based on the current environmental condition. Accordingly, the COPC screening was conducted using the 2017-2020 dataset described above, with preference to the most recent results. This was especially important in the CBP area where CO_2 treatments resulted in an improvement in the condition (see Attachment D). For each well, it was determined (through database queries), the most recent time that each analyte was sampled. These most recent monitoring records for a given analyte in a given well were used for the COPC screening. Given the contrast in the groundwater condition between the Satilla Fm as compared to the Ebenezer Fm, the dataset was segregated accordingly for the COPC screening.

3.2.2 CBA Subsurface

Investigation of the CBA dates back to 1981 involving geotechnical investigations of settlement. Structural foundation stabilization ensued with installation of a network of subgrade pilings (reported to have been driven to the sandstone layer) in each of the buildings, and pouring of a new floor slab.

Between 1994 and 1995, two investigations during the removal response action targeted shallow soil across the footprint of the CBA including soil beneath the cell building foundations. The initial investigation collected shallow soil with a hand auger, either in the soil adjacent to each cell building or beneath the building after coring through the concrete foundation slab. In 1995, the soil study was expanded to include mechanical excavation (*i.e.*, test pits) in areas of interest to allow for a more thorough assessment of the possible accumulation of metallic mercury beneath the floor slabs (no such condition was discovered).

Additional characterization of the CBA was performed in 1996-1997 under the Cell Building Area Subsurface Investigation ("CBASI") program. The CBASI was in part designed to more intensively investigate deep soils underlying the CBA (as well as other possible locations on the Site) for metallic mercury release. The most recent CBA characterization occurred in 2018 and comprised of continuous soil coring to the base of the Satilla across the CBA. Each core was examined for elemental mercury and indicators of petroleum and tested accordingly.

The COPC screening was developed from a database query that extracted all soil records for a given analyte located within the bounds of the CBA EU. Data sets for each exposure scenario were selected on the basis of the depth the sample was collected, where the top of the sampled interval ("D1") is the shallow extent of the soil sample and the base of the sampled interval ("D2") is the basal extent of the soil sample, where both D1 and D2 are ft-bgs.

The addition of the soil cover during the removal response action in late 1996 resulted in an increase in depth below the surface to where the original samples were collected. The depths of the pre-cover soil samples were adjusted in the database according to the thickness of the clean cover soil, prior to data set extraction. Post 1996 soil sample records did not require adjustment as the sample depth was recorded in reference to the existing soil cover topography. Attachment A provides further details about this depth adjustment and the dataset used for the CBA EU.

The depth intervals of interest for the CBA EU are the same as those that were used in the OU3 HHBRA, namely surface soil and mixed soil. The table below shows the sample collection depths (D1 and D2) that were used to query the database for each soil horizon of interest. These are the same criteria used in the OU3 HHBRA. Figure 4 shows the locations of the samples that fit these criteria.

Soil Horizon	Receptors	Applicable Depth	D1	D2
Surface Soil	*Industrial Worker/ Residential/Trespasser*	*Upper 2 ft*	*< 1 ft*	*≤ 2 ft*
Mixed Soil	*Excavation Worker*	*Upper 5 ft*	*< 5 ft*	*≤6 ft*

An outcome of the soil sample depth adjustment presented in Attachment A was that a limited number of sample locations occurred for the surface soil interval (primarily occurring at the perimeter of the EU where the soil cover tapers to the base grade) due to the construction of the CBA soil cover. Furthermore, the locations that qualify as surface soil were only tested for mercury and not the broader list of COPCs. To address this data limitation, Montrose recently submitted a work plan (Montrose, 2021) proposing additional surface soil sampling in the CBA

EU. Once this work plan is approved and the field work occurs, the resultant data will be incorporated into the HHBRA and/or RI Report, as appropriate based on timing[1].

3.3 COPC Screening Process

The COPC screening process followed EPA Region 4 guidance (EPA, 2018) and the HHBRA conducted for OU3 (EPS, 2012) using the EPA Regional Screening Levels ("RSLs") for residential setting, where RSLs were set at the lower of a 1 x 10^{-6} ELCR for carcinogenic compounds and a target hazard quotient ("HQ") of 0.1 for non-carcinogens (EPA, 2020b). The determination of whether a constituent was a COPC was based upon the following criteria:

1. Elimination of constituents for which the maximum detected concentration in a particular EU did not exceed the RSL;
2. Elimination of essential human nutrients (EPS, 2012): calcium, chloride, iodine, magnesium, phosphorus, potassium and sodium; and
3. Elimination of constituents that were detected in fewer than 5% of the samples, with the added provision that no more than 5% of the results for those constituents could have detection limits above the RSLs.

In instances where a constituent detected did not have an RSL value, a surrogate assignment of an RSL value was made from a constituent of similar physical/chemical property: note that a surrogate assignment list was provided by EPA Region 4 for the OU3 HHBRA that was applied herein (Attachment B). The COPC screening is presented for groundwater in Table 1 (Satilla Fm) and Table 2 (Ebenezer Fm), and for the soil in Table 3 (mixed soil) and Table 4 (surface soil).

[1] Once the computational worksheets are set up for the risk characterization, any updates to the EPC values are readily incorporated and updated risk/hazard calculations performed.

5 EXPOSURE ASSESSMENT WORK PLAN

5.1 Overview

Exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of human exposure to COPCs. The exposure assessment describes current and future land use assumptions, characterizes exposure factors for potential receptors, discusses the mechanisms by which these receptors might potentially come in contact with COPCs in environmental media, and estimates the degree of contact between potential human receptors and these constituents. Exposure is defined for risk purposes as contact with constituents in environmental media at the outer boundaries of the body, such as the gastrointestinal tract (for ingestion route), skin (for the dermal route), and lung (for inhalation route). This information is integrated with estimates of exposure point concentrations ("EPCs") and intake assumptions to estimate quantitatively the exposure or dose. This TM presents the inputs that will be used in the Exposure Assessment, which will be conducted as part of the HHBRA.

5.2 Exposure Units

Groundwater will be evaluated as multiple EUs and the CBA soil will be evaluated as a single EU (approximately 6 acres).

5.3 Exposure Setting - Identification of Potential Receptors

The HHBRA will consider the same five exposure scenarios used in the OU3 HHBRA: (1) Commercial/Industrial Worker (current/future scenario), (2) Excavation Worker (future scenario), (3) Trespasser (current scenario), (4) Trespasser (future scenario); and (5) Hypothetical Resident (future scenario). More details concerning these receptors are presented in the following sections.

5.4 Potential Exposure Pathways (Conceptual Site Model)

5.4.1 Groundwater

A water well survey was completed in 1995 by the EPA that included the upland area surrounding the Site and Blythe Island across the Turtle River from the Site (EPA, 1995). No water supply wells were located in the immediate area of the Site with the nearest water wells located approximately 0.5 mile to the north of the Site side-gradient to the local area groundwater flow direction (see Figure 5A), and understood to be installed in the Rock Aquifer (underlying the Surficial Aquifer). The EPA sampled the wells to the north and they were found to be clean. Prior sampling of local residential water supply wells by the EPA (during the removal action) showed all results meet health-based criteria (*e.g.*, federal drinking water maximum contaminant levels) and exhibited no indication of Site-related influence (a conclusion reached by the EPA OSCs who oversaw the sampling activity). Figure 5B shows industrial and city/county water supply wells in the area, all of which draw from much deeper aquifers separated by multiple regional confining layers from the Surficial Aquifer of the Site.

The Site is currently zoned Basic Industrial and the anticipated future land use is industrial. Based on the current zoning for the Site (Basic Industrial), as well as on the ROD for OU1 and OU3, the Site property will be not be developed as residential. Honeywell is presently working with EPA on a property deed restriction to ensure no future residential use of the property and to preclude use of Site groundwater. For the sake of completeness, the HHBRA will include assessment of the shallow groundwater as a source of residential drinking water for a Hypothetical Resident. Exposure of Hypothetical Residents to groundwater will be evaluated via ingestion, dermal and inhalation exposure routes.

Volatile constituents in groundwater can move through the subsurface and enter buildings (called vapor intrusion) or excavation areas, where they may be inhaled by receptors. In the event that structures are built at the Site in the future, vapor intrusion will be evaluated for the future Industrial Workers and Hypothetical Residents using EPA's Vapor Intrusion Screening Level ("VISL") Calculator. The Excavation Worker scenario will also include evaluation of inhalation of vapors emanating from groundwater that might accumulate in a trench excavation.

The above scenarios are presented in the CSM for the Site groundwater (Figure 6). The CSM includes ingestion of groundwater, dermal contact with groundwater, and inhalation from groundwater use, as well as inhalation of vapors emanating from groundwater.

5.4.2 CBA EU Subsurface

Noted above, institutional controls will be put into place prohibiting residential land use and use of Site groundwater. The majority of the CBA EU contains 2ft or more of clean cover soil, thinning along the perimeter to 1ft or less (see Figure A-3, Attachment A). Accordingly, exposure to the CBA soil condition is realistically limited to only the Excavation Worker (a pathway previously evaluated under the OU3 HHBRA). Nevertheless, the HHBRA will also assess restricted use (*i.e.,* Industrial Worker exposure) and unrestricted use (*i.e.,* Trespasser and Hypothetical Resident exposure) per EPA Guidance (EPA, 2018) to the limits of available shallow soil data at the soil cover perimeter. Figure 7 depicts the CSM for the CBA EU and includes ingestion, dermal contact, and inhalation (fugitive dust and volatilization).

Industrial Worker Industrial Workers may potentially be exposed to surficial soil at the CBA EU. For the purposes of the risk assessment, workers will be assumed to be exposed to surficial soil (defined here as 0 to 2 ft-bgs) in the CBA EU, in the absence of any specific work gear (such as coveralls, gloves, etc.) other than commonly worn clothing. The current/future Industrial Worker scenario will include constituent exposure via incidental ingestion of and dermal contact with surface soil, and inhalation of particulates and vapors in air.

Trespasser Trespassers may also potentially be exposed to surficial soil at the CBA EU. The majority of the CBA EU is fenced. Additionally, the entrance to the LCP Site and property line along Ross Road are gated and fenced. The north and south property lines are also fenced. Security measures at the Site currently include personnel (during weekly business hours) to prevent unauthorized entrance to the Site. Access to the Site from the west is restricted by the adjacent marsh. The soil cover on the surface of the CBA limits the potential for exposure to Site soil. Nevertheless, the Trespasser scenario will evaluate potential exposure to COPCs via ingestion of and dermal contact with surficial soil, and inhalation of particulates and vapors in air. To mirror the OU3 HHBRA, separate risks for current and potential future trespassers will be calculated. These scenarios differ only with respect to the assumptions about the frequency with which trespassers might access the property. Under the current scenario, access is assumed to be limited by the security measures described above. Under the future scenario, the exposure frequency will be increased, (conservatively) reflecting the possibility that Site access might not be controlled as tightly in the future.

Excavation Worker In the event that any surface or subsurface excavations were to occur in the CBA, future Excavation Workers potentially could come in contact with constituents in a "mixed soil" interval consisting of both surficial and subsurface soil (defined here as 0 to 5 ft-bgs). For the purposes of the risk assessment, Excavation Workers will be assumed to be exposed to soil in the absence of any specialized protective equipment or clothing other than commonly worn protective clothing. The Excavation Worker scenario will include potential exposure to constituents via ingestion, dermal contact, and inhalation of particulates and vapors potentially released from the soil during excavation activities.

Hypothetical On-Site Resident Future use of the Site is anticipated to remain largely commercial/industrial, although some portions of the Site may be amenable to less restrictive future land use. Honeywell has no intention of converting any portion of the property to residential use, and this restriction will be recorded (*i.e.,* deed restriction per the OU3 ROD) in the event the property or portions thereof are sold in the future. However, it is common practice with any HHBRA to evaluate a scenario involving residential reuse of the Site. Additionally, the hypothetical future Resident risk characterization will be useful as a conservative surrogate for virtually any type of unrestricted land use and, as such, the analysis may be useful to future land planning. The Hypothetical Resident could be exposed to surficial soil in the CBA EU via ingestion of and dermal contact with surficial soil, and inhalation of particulates and vapors in air.

5.4.3 Protection of Groundwater

Soil leachability from the vadose zone (above the high-water table horizon) was evaluated previously in the OU3 RI Report (EPS, 2013) and the OU3 FS Report (EPS, 2019) for the entire Site except the CBA footprint. Soil in the vadose zone in the CBA footprint will be evaluated in the OU2 RI Report in the same manner as OU3. The condition below the high water-table horizon is saturated soil and as such is evaluated in the RI/FS in terms of serving as a source for a dissolved-phase groundwater plume.

5.5 Exposure Parameters

Quantification of theoretical exposure of receptors to COPCs is a function of the concentration of the COPC and various exposure parameters that define both the conditions of exposure (*e.g.*, frequency of exposure, duration of exposure) and descriptors of potentially exposed receptors (*e.g.*, body weight, and ingestion rate). Exposure parameters refer to all of the variables used to calculate a daily human dose or intake level. The average daily dose ("ADD") of each non-carcinogenic

COPC is averaged over the estimated period of exposure, which varies based on the receptor. For carcinogenic COPCs, daily dose is averaged over the lifetime of the receptor and is referred to as the lifetime average daily dose ("LADD"). The exposure factors and equations that will be used to calculate the ADD and LADD are presented in Attachment C. Some of the exposure assumptions (such as exposure frequencies and applicable soil depths) were selected to be consistent with the OU3 HHBRA. However, the majority of the intake factors (such as body weight and ingestion rates) were updated to reflect factors currently used in the EPA RSL calculations. The equations are the same as those used by the EPA in generating the RSL tables.

In accordance with EPA guidance (1989), the exposure factors used in the HHBRA are intended to estimate both reasonable maximum exposure ("RME") and central tendency exposure ("CTE") to provide context to the range of possible hypothetical exposures at the Site. RME is defined as "the maximum exposure that is reasonably expected to occur at a site" and EPA has indicated that individual factors included in estimating exposure for an RME receptor should result in a final exposure estimate that approximates and upper percentile from a range of possible exposure estimates (EPA, 1991).

5.6 Exposure Point Concentrations

5.6.1 Overview

The EPC is the representative concentration of a given COPC with which the receptor is potentially in contact. A representative COPC-specific EPC value is incorporated into the exposure assessment equations from which potential human exposures are calculated. The EPC is intended to be a conservative estimate of the average concentration at a given point in time (EPA, 2014).

EPA guidance (EPA, 1992; 2002) indicates that the COPC-specific RME EPC shall be the lesser of either (i) the 95% upper confidence limit ("UCL") of the arithmetic mean or (ii) the maximum detected concentration. The purpose for using the 95% UCL instead of the average concentration is to account for "the uncertainty associated with estimating the true average concentration at a site…[and] the 95% UCL provides reasonable confidence that the true site average will not be underestimated" (EPA, 1992). These values will also be used to evaluate the CTE exposure scenarios.

5.6.2 Groundwater EPC

EPA Region 4 guidance (EPA, 2018) recommends that groundwater EPCs be calculated in accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* ("Guidance", EPA, 2014). The Guidance includes both a spatial aspect ("from the core of the plume") and a temporal aspect (recent data).

Spatial Consideration A site such as LCP with a complex and geographically-diverse groundwater COC condition does not lend itself to the concept of a traditional 'plume core'. A cumulative point (well) risk/hazard analysis was used to identify the plume cores posing the highest risk, from which a group of wells is then identified to be used to quantify the EPC. The details and results of this analysis are presented in Attachment D. The chemical nature, via the relative contribution of a given COPC to the pooled risk/hazard, is also developed from this analysis. The analysis concludes the following plume cores:

North Satilla Plume Core

- Primary COPCs characteristic of petroleum hydrocarbons (naphthalene and isomers, benzene and isomers) and arsenic
- Comprised of well clusters # MW-110, MW-111, MW-301, MW-302, MW-303, MW-308, MW-309, MW-310, and MW-311

South Satilla Plume Core

- Primary COPCs comingling of CBP-mobilized metals and petroleum hydrocarbons
- Comprised of well clusters #MW-104, MW-105, MW-112, MW-115, MW-352, MW-353, MW-354, MW-356, MW-357, MW-358, MW-362, MW-501, MW-502, MW-503, MW-504, MW-505, MW-506, MW-507, MW-508, MW-509, MW-510, MW-511, MW-512, MW-513, MW-514, MW-515, MW-516, MW-517, MW-518, MW-519

South Ebenezer Plume Core

- Primary COPCs comprised of caustic-mobilized metals with lesser petroleum hydrocarbons
- Comprised of wells #HWEast4, HWEast5, HWWest2, HWWest3, HWWest4, MW-115D, MW-360D

Temporal Consideration

Groundwater data has been collected at the Site for 25 years. The most recent Site-wide groundwater sampling event was conducted in the fall of 2017 after remedial action was taken at the Site. In 2017, 125 wells were sampled one year following the Phase 1-3 CBP treatment, when OU2 RI activities re-engaged. Additional more focused groundwater sampling events were performed in 2018 and 2019. Phase 2 of the CO_2 CBP treatment, centered in the CBA, was performed in late 2019, followed by a sampling event in August 2020 primarily to address data gaps determined by the agencies in the review of the OU2 Site Characterization Summary Report.

The preference expressed in the Guidance is to use data from the latest two rounds of sampling for each selected well and within the last year to represent current site conditions. This preference likely assumes a routine RCRA monitoring program as being in place (*e.g.*, involving quarterly or semi-annual monitoring across the well network), which was not the case with the LCP Site. The Guidance recognizes site-specific elements such as the groundwater CSM, should be taken into consideration when selecting the timeframe of the groundwater monitoring record for use in the EPC. Refer to Attachment D for details, which concludes the following with respect to temporal considerations:

North Satilla Plume Core

- Petroleum hydrocarbons dominate the condition resulting from a smear zone, serving as a COPC source dating back to the early 1900s with a stable plume condition.

- This CSM supports the aggregation of data records across the recent set of sampling events (2017-2020). This will result in a total 18 data records for each COPC to be used in calculating the EPCs (see Attachment D for more details).

South Satilla Plume Core

- This plume is characterized with primarily a residual metals condition (CBP), which has been under a state of general decline across the RI history, with some of the metals decline accelerated by the CO_2 treatments.
- Thus, it is more appropriate to limit the temporal data set to the most recent sampling event (2020), which targeted a large number of wells of interest from the Site Characterization Summary Report review. Of the 63 wells in this plume core, 27 were sampled in 2020. Thus, there will be a total of 27 records for calculating the EPCs (see Attachment D for more details).

South Ebenezer Plume Core

- COPC conditions are significantly lower than the Satilla and exhibited an increasing trend through earlier monitoring but reversing/stabilizing in the more recent period (2017-2020).
- CO_2 treatment of the overlying Satilla groundwater serves to address the source of the Ebenezer condition and longer term the Ebenezer condition is expected to improve, thus use of the aggregated 2017-2020 data is conservative and appropriate. Each the 7 wells in this plume core have been sampled five times since 2017, resulting in 35 records to be included in the EPC calculations (see Attachment D).

EPCs will be developed for the COPCs from Table 1 (Satilla Fm) for the North Satilla Plume Core and the South Satilla Plume. EPCs for the COPCs shown in Table 2 will be calculated for the Ebenezer Plume Core. An EPC for each COPC in each plume core will be set as the lesser of the 95% UCL or the maximum detected concentration. The 95% UCL will be calculated using EPA's ProUCL software package, which evaluates the "goodness of fit" of the data distribution for each data set. The software evaluates the distribution (*e.g.*, normal, lognormal) of the dataset and utilizes multiple statistical techniques (*e.g.*, student's t-test, Chebyshev methods, bootstrap methods) to calculate multiple 95% UCLs, then suggests which of the UCLs to use based on data size, data distribution and skewness.

5.6.3 Soil EPC

The soil EPCs for each depth interval will be set as the lesser of the 95% UCL (calculated using EPA's ProUCL software) or the maximum detected concentration. The following principles will be used to determine the datasets used for soil EPC calculations:

- Soil sample depth applicable to each land use scenario will adhere to the depth selection process as detailed in Section 3.2.2:

Scenario	Applicable Depth	D1	D2
Industrial Worker/ Residential/Trespasser	*Upper 2 ft*	*< 1*	*≤2 ft*
Excavation Woke	*Upper 5 ft*	*< 5 ft*	*≤6 ft*

- The historical sampling depth (pre-1997) has been adjusted to account for the clean soil cover and concrete slabs (as described in Attachment A).
- Duplicate results (*e.g.,* blind sample duplicates) will not be included.
- All existing sampling results will be used to determine the EPC; note that historical results tend to exhibit elevated detection limits and will be addressed as a point of uncertainty.

As shown in Figure A-2 of Attachment A, the vast majority of the CBA EU is covered by a soil cover. Approximately 14% of the CBA EU (on the periphery) has less than one foot of cover soil. Accordingly, a receptor that encounters only surface soil (Industrial Worker, Trespasser, and Hypothetical Resident) in this EU with exposure across the entire EU would only encounter Site soil 14% of the time; thus, their total soil intake would be 14% of Site soil and 85% clean fill. Accordingly, the EPC for surface soil will be adjusted by a Fraction Ingested ("FI") term, as recommended by the EPA risk assessor.

$$\text{EPC Surface EU} = \text{FI} \times \text{Surface Soil EPC}$$

where

EPC Surface EU: the EPC to be used in risk calculations for surface soil

FI: 0.14

Surface Soil EPC: 95% UCL or maximum detected concentration of surface soil data

5.7 Quantification of Exposure

To quantify the theoretical exposure of receptors to all COPCs, concentrations of each COPC are combined with the exposure parameters to estimate a daily dose that the receptor would have. As described in Section 4.5, the equations to calculate the daily doses (ADD and LADD) are presented in Attachment C. The equations are the same as those used for the EPA's RSLs.

6 UNCERTAINTY EVALUATION

COPC Screening Process. Constituents were selected as COPCs based on comparisons between the maximum detected concentration and conservative risk-based screening criteria (*i.e.*, USEPA residential RSLs). Both the use of the maximum concentrations and conservative screening values are an upper-bound representation of potential risk. A number of detected constituents did not have an RSL. RSLs for toxicological "surrogates" for some of these constituents were used in the screening process. There were also a number of constituents with no or limited detected results, but for which more than 5% of the data records have analytical detection limits that exceed the relevant RSL values. These constituents could not be completely eliminated as COPC based on the detection limits and were identified as "Qualitative COPCs." There is also inherent uncertainty related to sample counts.

Environmental Sampling and Analysis. This risk assessment is based on the sampling results obtained from the various investigations at the property, often biased to locations of suspected contamination. Variability in sampling results can arise from various components including field sampling, laboratory analyses, and test methods. These elements are inherent in any long-term and complex site assessment such as involved with this Site, and are judged to have minimal impact on the overall assessment of risk.

Sample Density. The presence of the clean soil cover over the majority of the CBA EU results in there being only seven soil samples within the top 2 ft of soil. These seven samples were only analyzed for mercury; thus, there is uncertainty in the make-up of the surface soil on the periphery of the EU. To address this data uncertainty, Montrose recently submitted a work plan (Montrose, 2021) proposing additional surface soil sampling in the CBA EU. The HHBRA will be updated with the added surface soil sampling results should it be available prior to the scheduled submittal, otherwise the RI Report will provide the updated risk characterization.

Exposure Assumptions. The exposure assessment framework is based on a number of assumptions with varying degrees of uncertainty. Uncertainties can arise from the types of exposures examined, the points of potential human exposure, the concentrations of COPCs at the points of human exposure, and the intake assumptions. The selection of exposure pathways is a process, often based on best professional judgment that attempts to identify the most probable potentially harmful exposure scenarios. In the absence of a value for a particular exposure parameter, professional judgment based on site conditions will be used. Individuals can come into contact with chemicals via a number of different exposure routes. Standard default rates will be used for most exposures. These represent upper-bound values and provide reasonable maximum activity assumptions. The use of these standard default and upper-end values makes it likely that the risk is not underestimated, and may in fact be overestimated.

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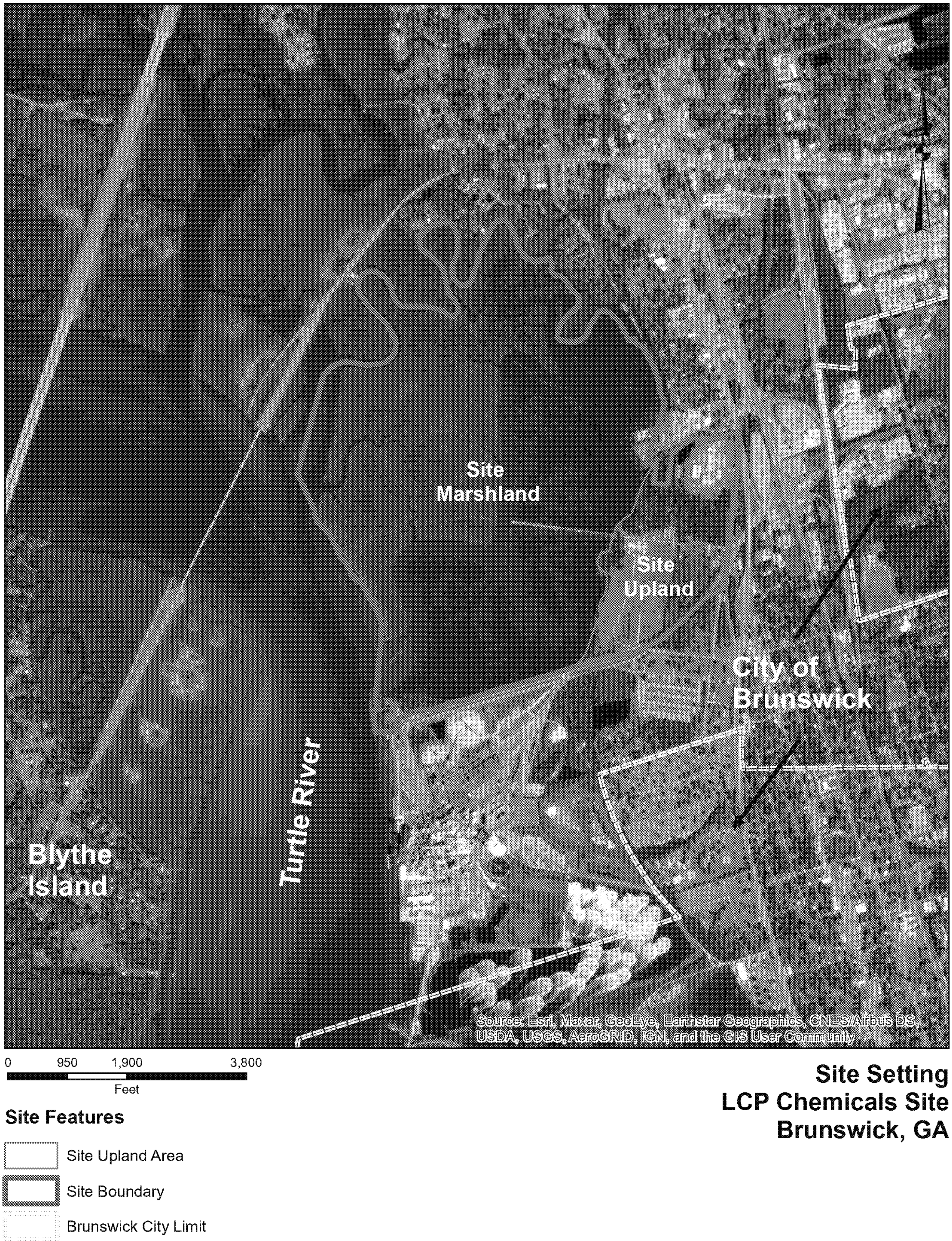
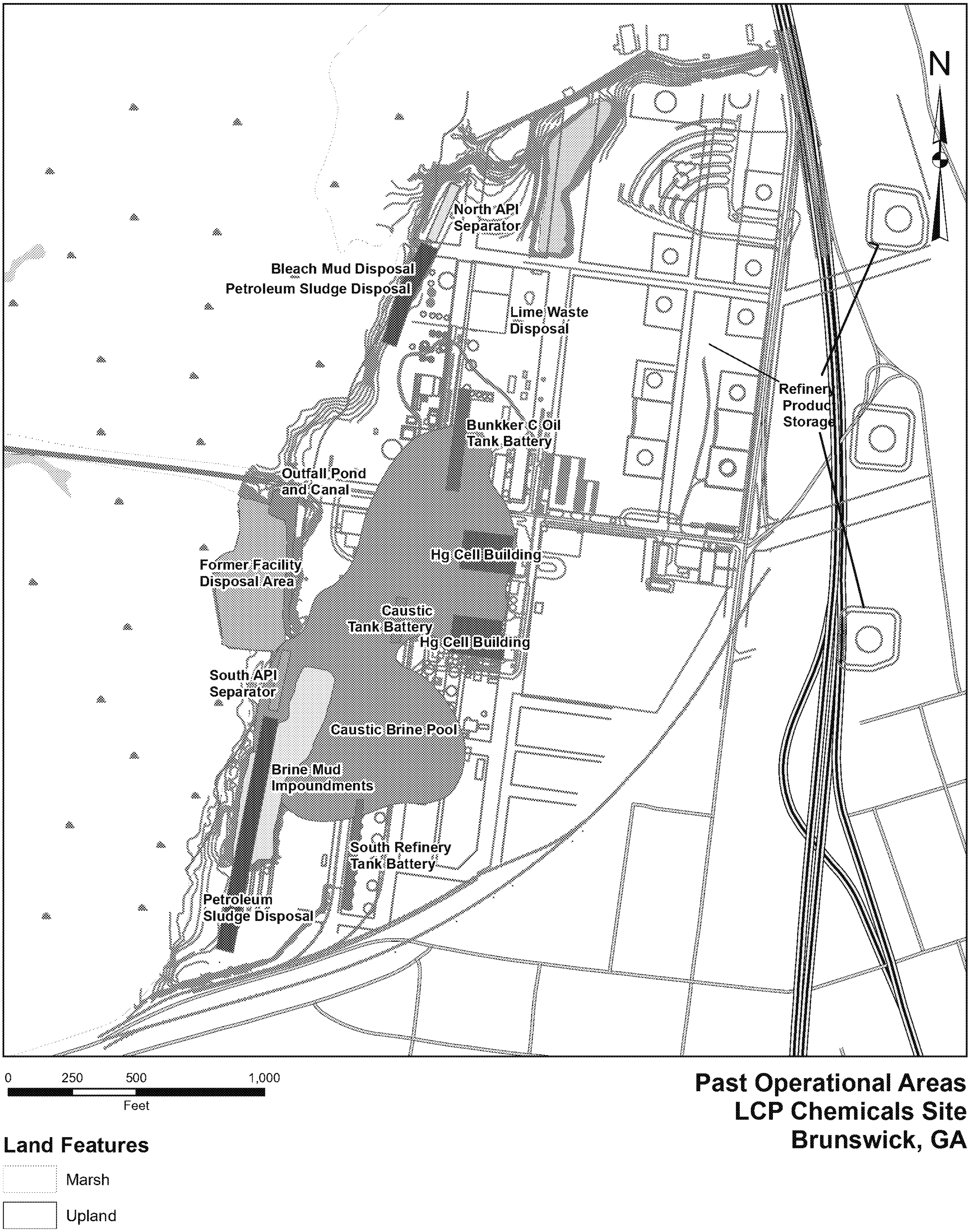
FIGURES



Site Setting
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

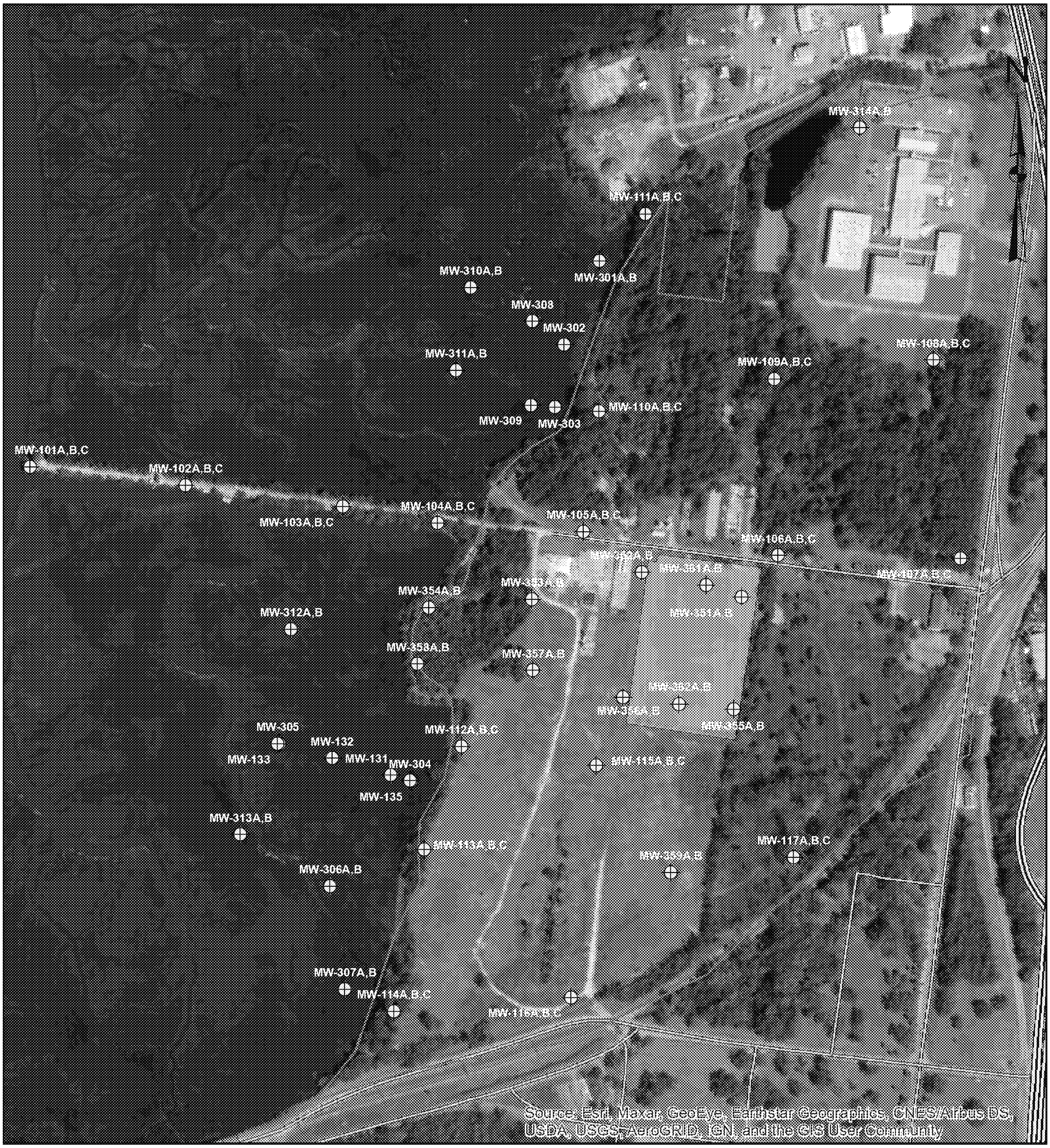
Figure No.1



Past Operational Areas
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No.2



0 250 500 1,000

Feet

Site Features

Upland Boundary

Cell Building Area Soil Cover

Monitoring Well Status

Satilla Monitoring Wells

Satilla EU Monitoring Well Network LCP Chemicals Site Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No.3A

0 250 500 1,000
Feet

Ebenezer EU Monitoring Well Network
LCP Chemicals Site
Brunswick, GA

Site Features

Upland Boundary

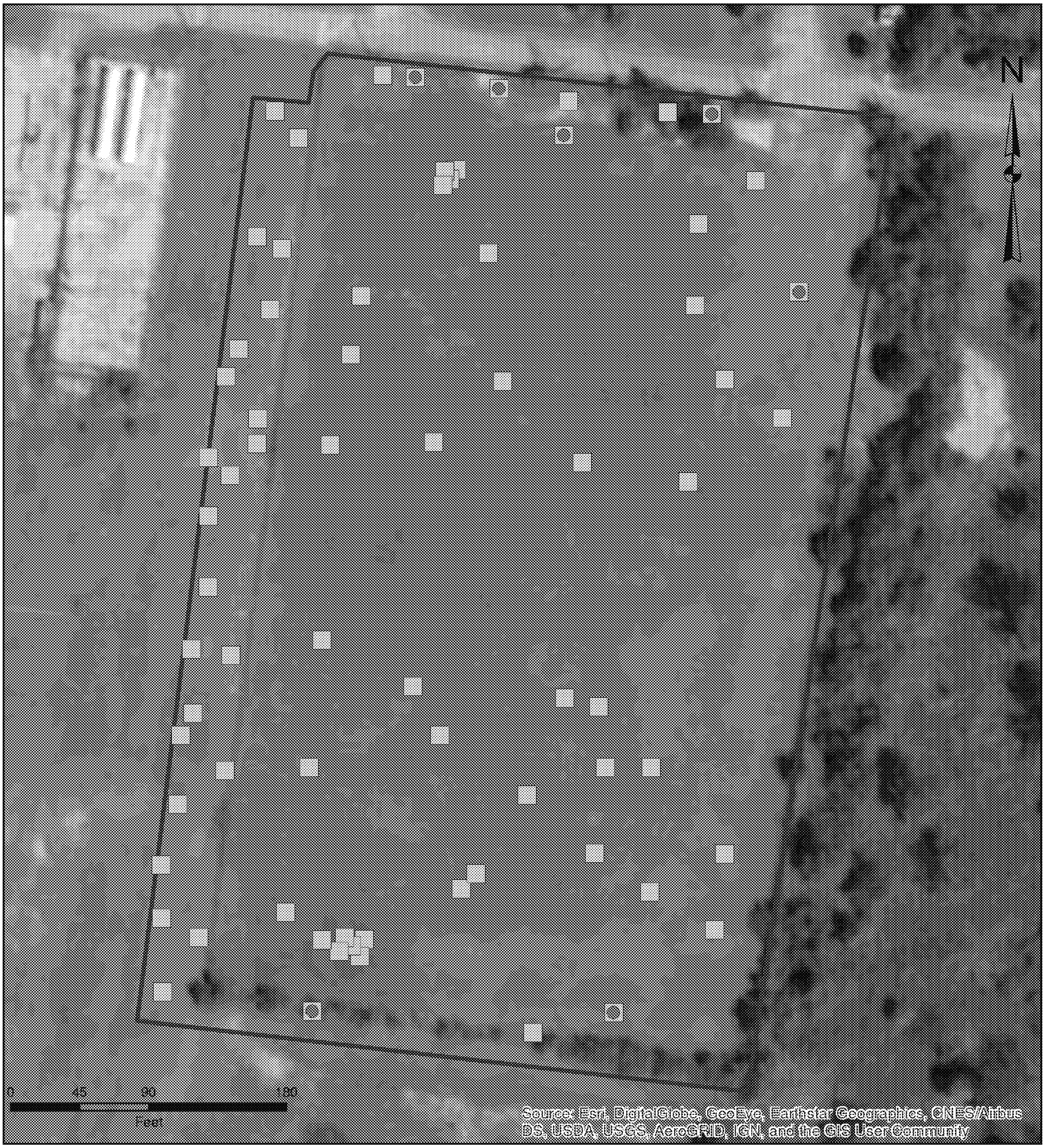
Cell Building Area Soil Cover

Monitoring Well Status

Ebenezer Verticle Monitoring Wells

Ebenezer Horizontal Well

Figure No.3B



Surface Soil (0-2 ft)

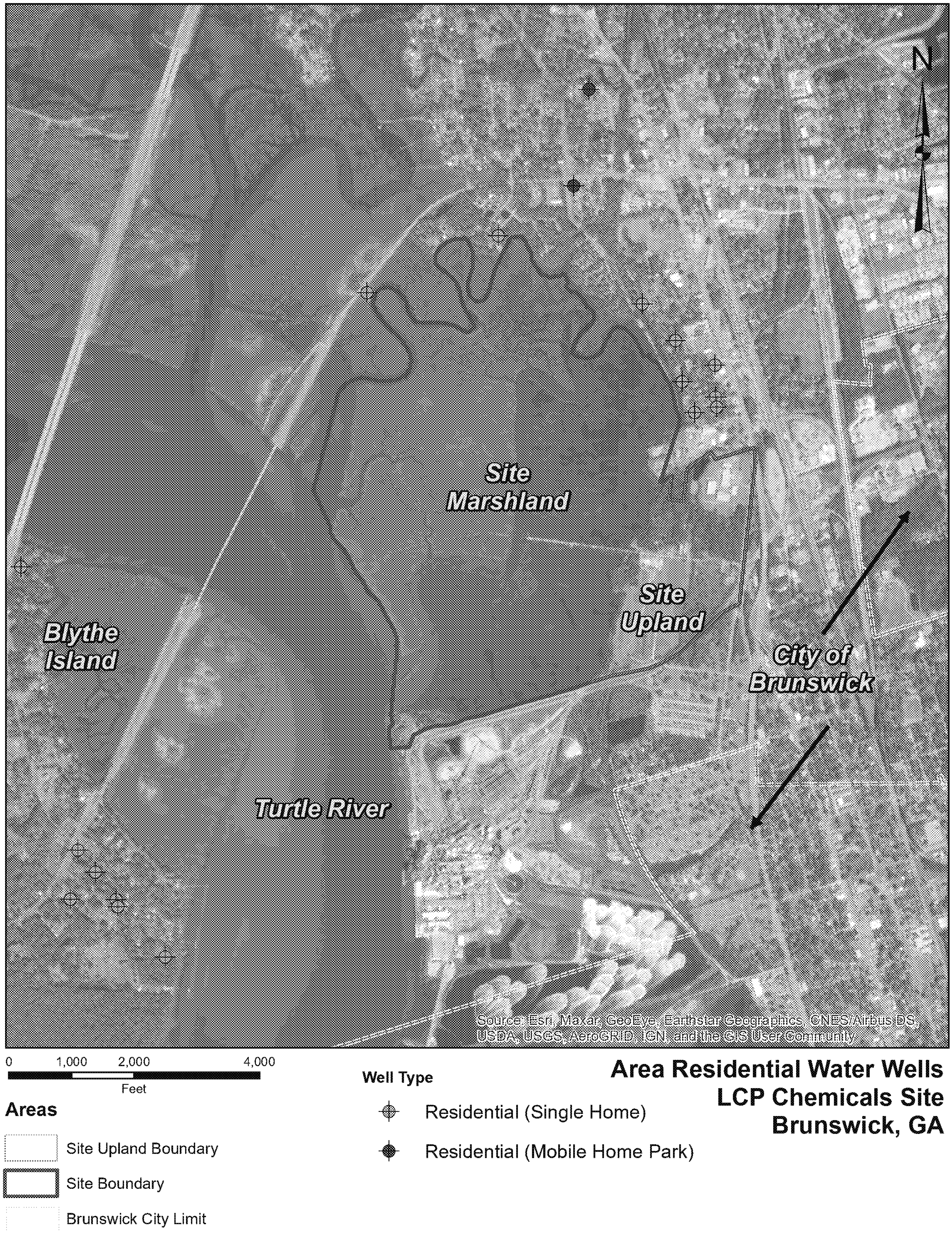
Mixed Soil Samples (0-5 ft)

CBA Exposure Unit

CBA EU Soil Sample Locations
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

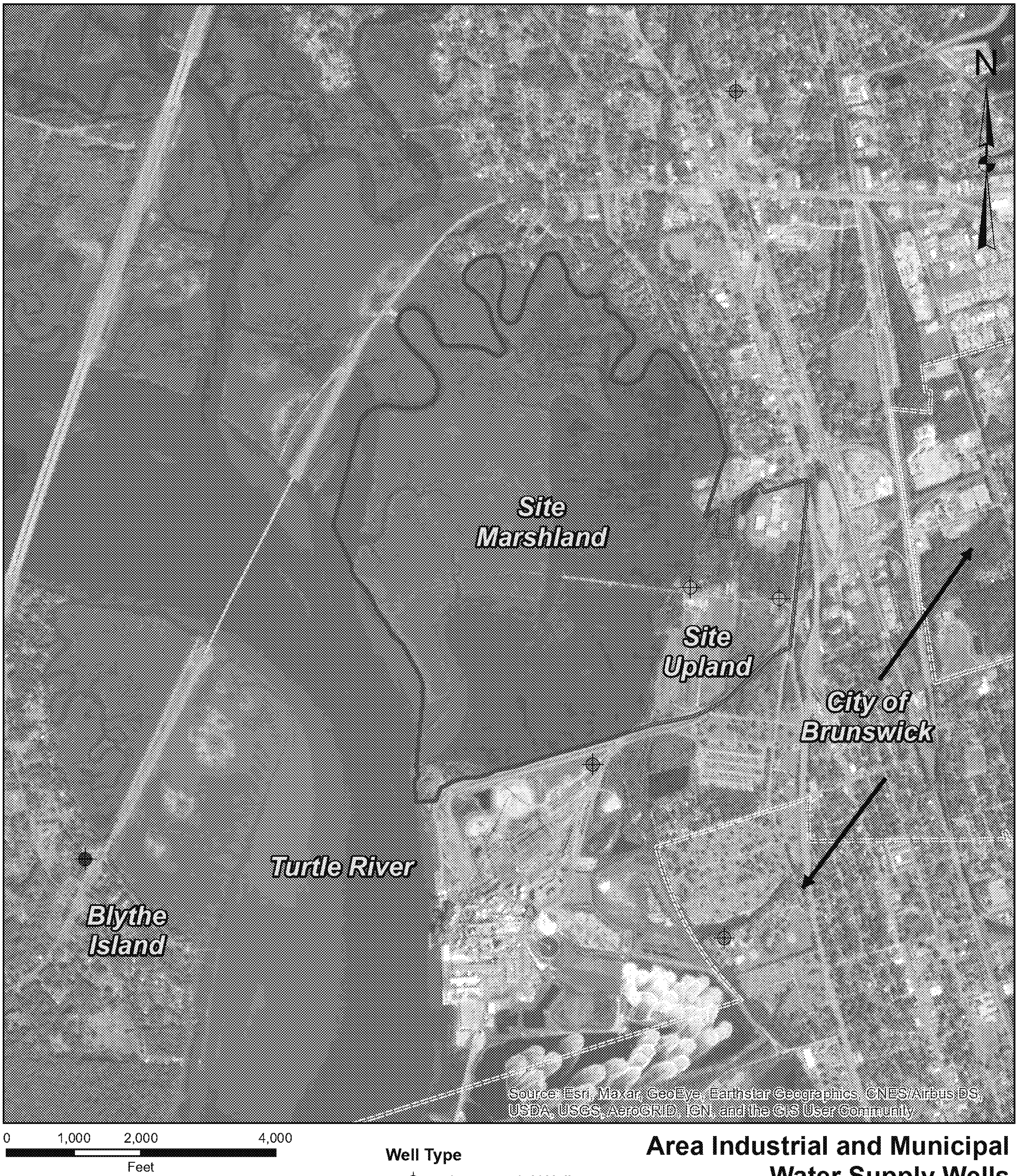
Figure No. 4



Area Residential Water Wells
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No.5A



Areas

- Site Upland Boundary
- Site Boundary
- Brunswick City Limit

Well Type

- Commercial Well
- Industrial Well
- Site Well

Area Industrial and Municipal Water Supply Wells LCP Chemicals Site Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No.5B

Figure 6
Human Health Conceptual Site Model - OU2 Groundwater

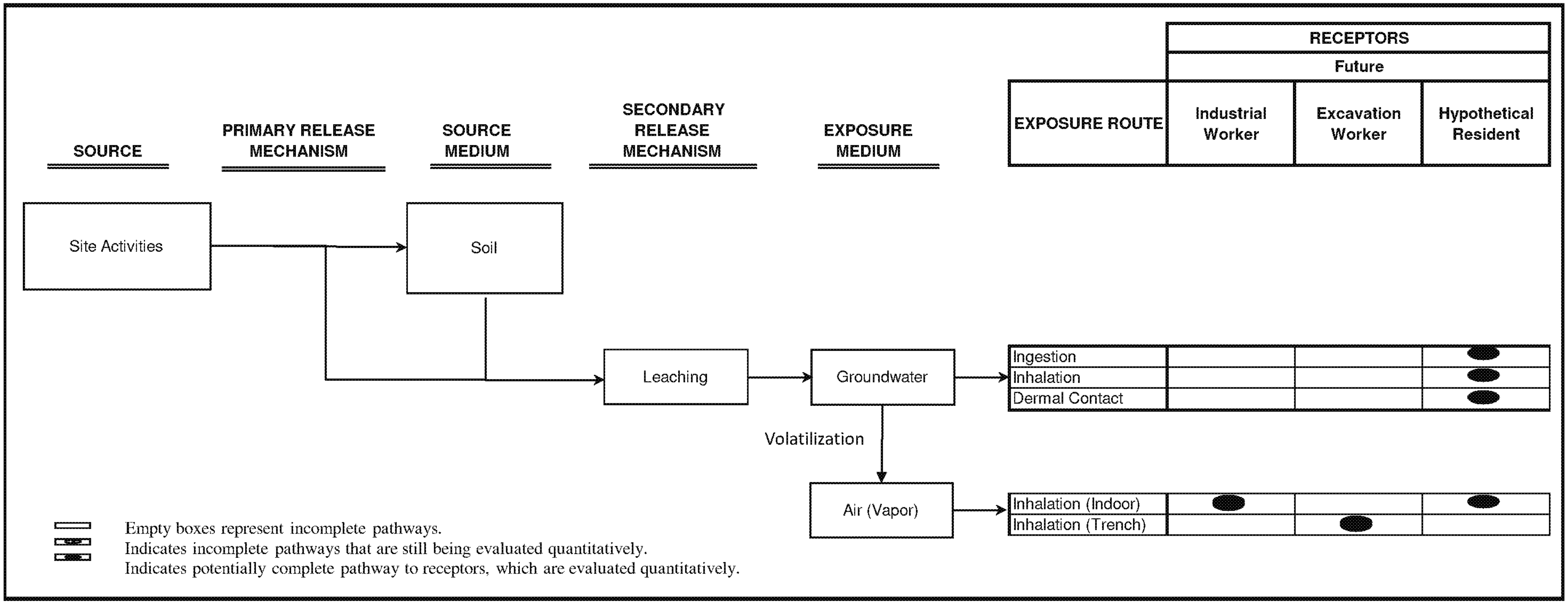
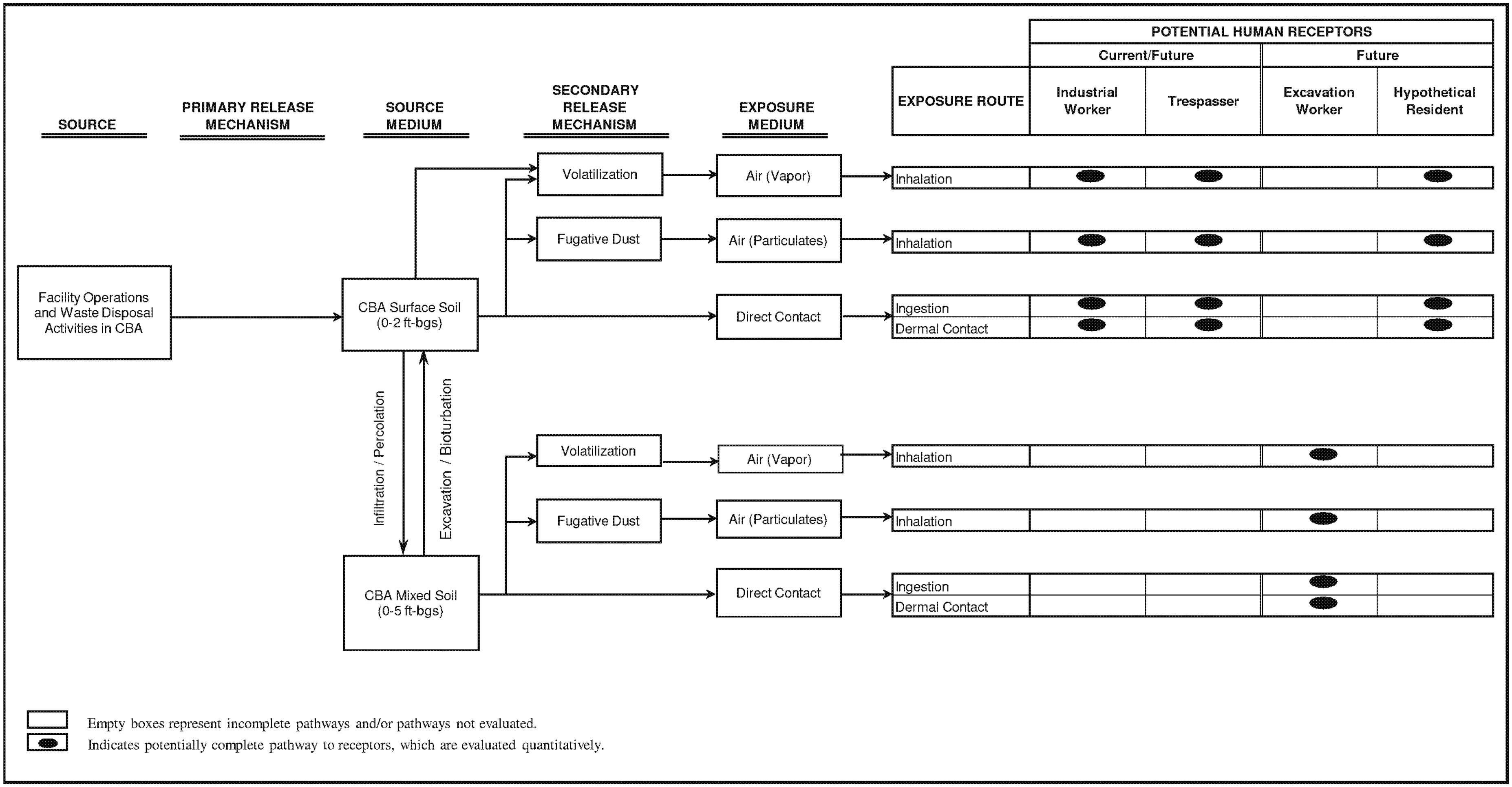


Figure 7
Human Health Conceptual Site Model - CBA Soil



TABLES

Table 1. Groundwater COPC Selection - Satilla Formation

Parameter	Surrogate [1]	Detection Frequency	% Detects	Min Detect (µg/L)	Max Detect (µg/L)	Min DL for ND (µg/L)	Max DL for ND (µg/L)	MCL (µg/L)	Res RSL [2] (µg/L)	# Detects > RSL	# DL [3] > RSL	# DL > MCL	COPC?	Basis
VOCs														
1,1,1,2-Tetrachloroethane		0/135	0%			0.07	140		0.57		73		Qualitative	Not detected; DLs above RSLs
1,1,1-Trichloroethane		0/135	0%			0.06	120	200	800		0	0	No	No Detects, All DL < RSL
1,1,2,2-Tetrachloroethane		3/135	2%	0.11	0.75	0.07	140		0.076	3	126		Yes	Detects > RSL
1,1,2-Trichloroethane		1/135	1%	22	22	0.06	120	5	0.041	1	134	8	Yes	Detects > RSL
1,1-Dichloroethane		31/135	23%	0.11	6.1	0.07	140		2.8	3	19		Yes	Detects > RSL
1,1-Dichloroethene		6/135	4%	0.09	4.8	0.06	120	7	28	0	4	5	No	Detects < RSL
1,1-Dichloropropene	1,3-Dichloropropene	2/135	1%	0.26	1.2	0.05	100		0.47	1	72		Yes	Detects > RSL
1,2,3-Trichloropropane		2/135	1%	0.46	1.2	0.1	200		0.00075	2	133		Yes	Detects > RSL
1,2,4-Trimethylbenzene		54/135	40%	0.07	570	0.06	120		5.6	20	7		Yes	Detects > RSL
1,2-Dibromo-3-chloropropane		1/135	1%	0.27	0.27	0.1	200	0.2	0.00033	1	134	127	Yes	Detects > RSL
1,2-Dibromoethane		2/135	1%	0.11	0.15	0.06	120	0.05	0.0075	2	133	133	Yes	Detects > RSL
1,2-Dichloroethane		3/135	2%	0.064	0.1	0.05	100	5	0.17	0	79	5	No	Detects < RSL
1,2-Dichloropropane		9/135	7%	0.13	3.6	0.06	120	5	0.82	2	37	8	Yes	Detects > RSL
1,3,5-Trimethylbenzene		36/135	27%	0.1	160	0.06	120		6	10	5		Yes	Detects > RSL
1,3-Dichloropropane		0/135	0%			0.07	140		37		2		Qualitative	Not detected; DLs above RSLs
2,2-Dichloropropane	1,3-Dichloropropane	2/135	1%	0.07	0.08	0.05	100		0.47	0	73		No	Detects < RSL
2-Butanone (MEK)		2/135	1%	4.8	17	0.6	1200		560	0	2		No	Detects < RSL
2-Chlorotoluene		6/135	4%	0.089	55	0.07	140		24	1	4		No	< 5% detect / < 5% DL >RSL
2-Hexanone		4/135	3%	0.76	15	0.6	1200		3.8	2	79		Yes	Detects > RSL
4-Chlorotoluene		2/135	1%	0.076	0.55	0.07	140		25	0	4		No	Detects < RSL
4-Methyl-2-pentanone		0/135	0%			0.7	1400		630		2		Qualitative	Not detected; DLs above RSLs
Acetone		55/135	41%	1.8	2100	0.9	1800		1400	1	1		Yes	Detects > RSL
Benzene		72/135	53%	0.08	54	0.05	100	5	0.46	55	36	5	Yes	Detects > RSL
Bromobenzene		0/135	0%			0.06	120		6.2		5		Qualitative	Not detected; DLs above RSLs
Bromochloromethane		0/135	0%			0.05	100		8.3		5		Qualitative	Not detected; DLs above RSLs
Bromodichloromethane		2/135	1%	0.068	0.56	0.05	100	80	0.13	1	79	2	Yes	Detects > RSL
Bromoform		0/135	0%			0.16	600	80	3.3		34	4	Qualitative	Not detected; DLs above RSLs
Bromomethane		0/135	0%			0.07	140		0.75		43		Qualitative	Not detected; DLs above RSLs
Carbon disulfide		78/135	58%	0.07	4.7	0.06	120		81	0	2		No	Detects < RSL
Carbon tetrachloride		0/135	0%			0.07	140	5	0.46		79	8	Qualitative	Not detected; DLs above RSLs
Chlorobenzene		41/135	30%	0.17	1400	0.06	120	100	7.8	22	5	2	Yes	Detects > RSL
Chloroethane		7/135	5%	0.1	5.1	0.07	140		2100	0	0		No	Detects < RSL
Chloroform		5/135	4%	0.24	1.1	0.072	180	80	0.22	5	75	2	Yes	Detects > RSL
Chloromethane		16/135	12%	0.08	5.3	0.06	120		19	0	4		No	Detects < RSL
cis-1,2-Dichloroethene		50/135	37%	0.07	15	0.05	100	70	3.6	5	8	2	Yes	Detects > RSL
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/135	0%			0.05	100		0.47		79		Qualitative	Not detected; DLs above RSLs
Dibromochloromethane		0/135	0%			0.07	140	80	0.87		37	2	Qualitative	Not detected; DLs above RSLs
Dibromomethane		0/135	0%			0.06	120		0.83		37		Qualitative	Not detected; DLs above RSLs
Dichlorodifluoromethane		0/135	0%			0.05	100		20		4		Qualitative	Not detected; DLs above RSLs
Dichloromethane (Methylene chloride)		36/135	27%	0.07	20	0.07	140	5	11	1	5	7	Yes	Detects > RSL
Ethyl benzene		62/135	46%	0.05	680	0.05	120	700	1.5	42	17	0	Yes	Detects > RSL
Isopropylbenzene		68/135	50%	0.06	56	0.05	100		45	1	2		Yes	Detects > RSL
m&p-Xylene	(m-Xylene)	44/135	33%	0.11	1700	0.1	200		19	6	5		Yes	Detects > RSL

Table 1. Groundwater COPC Selection - Satilla Formation

Parameter	Surrogate [1]	Detection Frequency	% Detects	Min Detect (µg/L)	Max Detect (µg/L)	Min DL for ND (µg/L)	Max DL for ND (µg/L)	MCL (µg/L)	Res RSL [2] (µg/L)	# Detects > RSL	# DL [3] > RSL	# DL > MCL	COPC?	Basis
n-Butylbenzene		31/135	23%	0.07	21	0.05	100		100	0	0		No	Detects < RSL
n-Propylbenzene		60/135	44%	0.06	58	0.054	120		66	0	2		No	Detects < RSL
o-Xylene		44/135	33%	0.09	170	0.05	100		19	4	4		Yes	Detects > RSL
p-Isopropyltoluene	Toluene	35/135	26%	0.07	19	0.05	100		110	0	0		No	Detects < RSL
sec-Butylbenzene		51/135	38%	0.062	24	0.06	120		200	0	0		No	Detects < RSL
Styrene		0/135	0%			0.05	100	100	120		0	0	No	No Detects, All DL < RSL
tert-Butylbenzene		52/135	39%	0.09	17	0.059	140		69	0	2		No	Detects < RSL
Tetrachloroethene		1/135	1%	1.1	1.1	0.06	120	5	4.1	0	8	8	No	Detects < RSL
Toluene		69/135	51%	0.07	430	0.054	140	1000	110	1	2	0	Yes	Detects > RSL
trans-1,2-Dichloroethene		9/135	7%	0.09	6.8	0.06	120	100	6.8	0	2	2	No	Detects < RSL
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/135	0%			0.06	120		0.47		73		Qualitative	Not detected; DLs above RSLs
Trichloroethene		8/135	6%	0.11	3.7	0.06	120	5	0.28	7	77	8	Yes	Detects > RSL
Trichlorofluoromethane		0/135	0%			0.05	100		520		0		No	No Detects, All DL < RSL
Vinyl chloride		4/135	3%	0.24	3.1	0.075	200	2	0.019	4	131	28	Yes	Detects > RSL
SVOCs														
1,2,3-Trichlorobenzene		0/135	0%			0.05	100		0.7		37		Qualitative	Not detected; DLs above RSLs
1,2,4-Trichlorobenzene		13/135	10%	0.12	58	0.06	120	70	0.4	10	77	2	Yes	Detects > RSL
1,2-Dichlorobenzene		36/135	27%	0.21	390	0.06	120	600	30	6	2	0	Yes	Detects > RSL
1,3-Dichlorobenzene	1,2-Dichlorobenzene	26/135	19%	0.07	110	0.06	120		30	2	2		Yes	Detects > RSL
1,4-Dichlorobenzene		30/135	22%	0.2	230	0.07	140	75	0.48	28	59	2	Yes	Detects > RSL
1-Methyl Naphthalene		101/135	75%	0.0043	110	0.0013	0.025		1.1	50	0		Yes	Detects > RSL
2-Methylnaphthalene		89/135	66%	0.0026	140	0.0023	0.1		3.6	20	0		Yes	Detects > RSL
Acenaphthene		85/135	63%	0.012	8	0.0012	0.11		53	0	0		No	Detects < RSL
Acenaphthylene	Pyrene	39/135	29%	0.0042	0.4	0.0011	0.44		12	0	0		No	Detects < RSL
Anthracene		78/135	58%	0.0037	1	0.00082	0.05		180	0	0		No	Detects < RSL
Benzo(a)anthracene		42/135	31%	0.0024	2	0.00097	0.05		0.03	20	14		Yes	Detects > RSL
Benzo(a)pyrene		28/135	21%	0.0088	1	0.0011	0.05	0.2	0.025	19	14	0	Yes	Detects > RSL
Benzo(b)fluoranthene		41/135	30%	0.0072	0.9	0.00083	0.05		0.25	5	0		Yes	Detects > RSL
Benzo(g,h,i)perylene	Pyrene	28/135	21%	0.0035	0.7	0.00086	0.05		12	0	0		No	Detects < RSL
Benzo(k)fluoranthene		13/135	10%	0.0045	0.2	0.00094	0.11		2.5	0	0		No	Detects < RSL
Chrysene		28/135	21%	0.0035	2	0.00076	0.05		25	0	0		No	Detects < RSL
Dibenzo(a,h)anthracene		4/135	3%	0.003	0.2	0.0013	0.22		0.025	2	26		Yes	Detects > RSL
Dibenzofuran		64/135	47%	0.01	3	0.00096	0.11		0.79	5	0		Yes	Detects > RSL
Fluoranthene		33/135	24%	0.0046	1	0.00082	0.057		80	0	0		No	Detects < RSL
Fluorene		78/135	58%	0.01	4	0.0011	0.05		29	0	0		No	Detects < RSL
Hexachlorobutadiene		0/135	0%			0.07	140		0.14		80		Qualitative	Not detected; DLs above RSLs
Indeno(1,2,3-cd)pyrene		25/135	19%	0.0052	0.3	0.00089	0.05		0.25	1	0		Yes	Detects > RSL
Naphthalene		111/135	82%	0.0041	420	0.0038	0.21		0.12	90	3		Yes	Detects > RSL
Phenanthrene	Pyrene	53/135	39%	0.0052	6	0.005	0.2		12	0	0		No	Detects < RSL
Pyrene		56/135	41%	0.0081	6	0.001	0.05		12	0	0		No	Detects < RSL

Table 1. Groundwater COPC Selection - Satilla Formation

Parameter	Surrogate [1]	Detection Frequency	% Detects	Min Detect (µg/L)	Max Detect (µg/L)	Min DL for ND (µg/L)	Max DL for ND (µg/L)	MCL (µg/L)	Res RSL [2] (µg/L)	# Detects > RSL	# DL [3] > RSL	# DL > MCL	COPC?	Basis
							Inorganics							
Aluminum		132/145	91%	3	95000	4	390		2000	54	0		Yes	Detects > RSL
Antimony		30/145	21%	0.02	4.09	0.02	16	6	0.78	6	24	15	Yes	Detects > RSL
Arsenic		108/145	74%	0.09	153	0.08	16	10	0.052	108	37	14	Yes	Detects > RSL
Barium		145/145	100%	1.31	2800			2000	380	14			Yes	Detects > RSL
Beryllium		122/145	84%	0.004	57	0.004	2.4	4	2.5	50	0	0	Yes	Detects > RSL
Cadmium		29/145	20%	0.008	2.7	0.006	3	5	0.92	3	19	0	Yes	Detects > RSL
Calcium		145/145	100%	71	686000								No	Essential nutrient
Chromium	Chromium, III	139/145	96%	0.06	1200	0.2	1.6	100	2200	0	0	0	No	Detects < RSL
Chromium, VI [4]		3/16	19%	41	112	40	40		0.035	3	13		Yes	Detects > RSL
Cobalt		98/145	68%	0.007	16	0.012	3.1		0.6	45	18		Yes	Detects > RSL
Copper		96/145	66%	0.04	210	0.03	12	1300	80	2	0	0	Yes	Detects > RSL
Iron		142/145	98%	10	52100	3	56		1400	82	0		Yes	Detects > RSL
Lead		112/145	77%	0.005	209	0.02	7.1	15	15	21	0	0	Yes	Detects > RSL
Magnesium		145/145	100%	29	613000								No	Essential nutrient
Manganese		139/145	96%	1.1	1590	0.3	63		43	84	1		Yes	Detects > RSL
Mercury		137/145	94%	0.00016	223	0.0003	0.25	2	0.063	91	2	0	Yes	Detects > RSL
Methyl mercury		8/8	100%	0.00529	0.357				0.2	1			Yes	Detects > RSL
Nickel		102/145	70%	0.04	170	0.04	12		0.083	97	36		Yes	Detects > RSL
Potassium		142/145	98%	140	180000	744	1100						No	Essential nutrient
Selenium		98/145	68%	0.08	146	0.07	22.3	50	10	36	17	0	Yes	Detects > RSL
Silver		4/145	3%	0.005	0.46	0.005	5		9.4	0	0		No	Detects < RSL
Sodium		145/145	100%	4470	17000000								No	Essential nutrient
Thallium		19/145	13%	0.007	8.8	0.006	8.1	2	0.02	12	107	13	Yes	Detects > RSL
Vanadium		135/145	93%	0.6	3200	0.5	8.58		8.6	102	0		Yes	Detects > RSL
Zinc		91/145	63%	0.3	1390	0.2	120		600	1	0		Yes	Detects > RSL

1) Surrogates not in parenthases taken from the approved surrogate list included in the OU3 HHBRA.
2) Tapwater RSLs from EPA RSL Tables Nov 2020; non-carcinogens evaluated for HQ of 0.1
3) Number of non-detected results with detection limits above the RSL.
4) Hexavalent chromium results from 2012 sampling event

Table 2 Groundwater COPC Selection - Ebenezer Formation

Parameter	Surrogate [1]	Detection Frequency	% Detects	Min Detect (µg/L)	Max Detect (µg/L)	Min DL for ND (µg/L)	Max DL for ND (µg/L)	MCL (µg/L)	Res RSL [2] (µg/L)	# Detects > RSL	# DL [3] > RSL	# DL > MCL	COPC?	Basis
VOCs														
1,1,1,2-Tetrachloroethane		0/19	0%			0.07	3.5		0.57		13		Qualitative	Not detected; DLs above RSLs
1,1,1-Trichloroethane		0/19	0%			0.06	3	200	800		0	0	No	No Detects, All DL < RSL
1,1,2,2-Tetrachloroethane		0/19	0%			0.07	3.5		0.076		16		Qualitative	Not detected; DLs above RSLs
1,1,2-Trichloroethane		0/19	0%			0.06	3	5	0.041		19	0	No	Not detected; DLs below MCL
1,1-Dichloroethane		0/19	0%			0.07	3.5		2.8		2		Qualitative	Not detected; DLs above RSLs
1,1-Dichloroethene		0/19	0%			0.06	3	7	28		0	0	No	No Detects, All DL < RSL
1,1-Dichloropropene	1,3-Dichloropropene	0/19	0%			0.05	2.5		0.47		13		Qualitative	Not detected; DLs above RSLs
1,2,3-Trichloropropane		0/19	0%			0.1	5		0.00075		19		Qualitative	Not detected; DLs above RSLs
1,2,4-Trimethylbenzene		0/19	0%			0.06	3		5.6		0		No	No Detects, All DL < RSL
1,2-Dibromo-3-chloropropane		0/19	0%			0.1	5	0.2	0.00033		19	16	Qualitative	Not detected; DLs above RSLs
1,2-Dibromoethane		0/19	0%			0.06	3	0.05	0.0075		19	19	Qualitative	Not detected; DLs above RSLs
1,2-Dichloroethane		0/19	0%			0.05	2.5	5	0.17		13	0	No	Not detected; DLs below MCL
1,2-Dichloropropane		0/19	0%			0.06	3	5	0.82		5	0	No	Not detected; DLs below MCL
1,3,5-Trimethylbenzene		0/19	0%			0.06	3		6		0		No	No Detects, All DL < RSL
1,3-Dichloropropane		0/19	0%			0.07	3.5		37		0		No	No Detects, All DL < RSL
2,2-Dichloropropane	1,3-Dichloropropane	0/19	0%			0.05	2.5		0.47		13		Qualitative	Not detected; DLs above RSLs
2-Butanone (MEK)		2/19	11%	26	32	0.6	30		560	0	0		No	Detects < RSL
2-Chlorotoluene		0/19	0%			0.07	3.5		24		0		No	No Detects, All DL < RSL
2-Hexanone		0/19	0%			0.6	30		3.8		13		Qualitative	Not detected; DLs above RSLs
4-Chlorotoluene		0/19	0%			0.07	3.5		25		0		No	No Detects, All DL < RSL
4-Methyl-2-pentanone		0/19	0%			0.7	35		630		0		No	No Detects, All DL < RSL
Acetone		6/19	32%	3.5	230	0.9	45		1400	0	0		No	Detects < RSL
Benzene		5/19	26%	0.05	2.6	0.05	2.5	5	0.46	4	10	0	**Yes**	Detects > RSL
Bromobenzene		0/19	0%			0.06	3		6.2		0		No	No Detects, All DL < RSL
Bromochloromethane		0/19	0%			0.05	2.5		8.3		0		No	No Detects, All DL < RSL
Bromodichloromethane		0/19	0%			0.05	2.5	80	0.13		13	0	No	Not detected; DLs below MCL
Bromoform		0/19	0%			0.16	15	80	3.3		5	0	No	Not detected; DLs below MCL
Bromomethane		0/19	0%			0.07	3.5		0.75		5		Qualitative	Not detected; DLs above RSLs
Carbon disulfide		8/19	42%	0.09	2.7	0.06	3		81	0	0		No	Detects < RSL
Carbon tetrachloride		0/19	0%			0.07	3.5	5	0.46		13	0	No	Not detected; DLs below MCL
Chlorobenzene		0/19	0%			0.06	3	100	7.8		0	0	No	No Detects, All DL < RSL
Chloroethane		0/19	0%			0.07	3.5		2100		0		No	No Detects, All DL < RSL
Chloroform		0/19	0%			0.072	4.5	80	0.22		13	0	No	Not detected; DLs below MCL
Chloromethane		1/19	5%	0.11	0.11	0.06	3		19	0	0		No	Detects < RSL
cis-1,2-Dichloroethene		1/19	5%	0.5	0.5	0.05	2.5	70	3.6	0	0	0	No	Detects < RSL
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/19	0%			0.05	2.5		0.47		13		Qualitative	Not detected; DLs above RSLs
Dibromochloromethane		0/19	0%			0.07	3.5	80	0.87		5	0	No	Not detected; DLs below MCL
Dibromomethane		0/19	0%			0.06	3		0.83		5		Qualitative	Not detected; DLs above RSLs
Dichlorodifluoromethane		0/19	0%			0.05	2.5		20		0		No	No Detects, All DL < RSL
Dichloromethane (Methylene chloride)		2/19	11%	0.12	2	0.07	3.5	5	11	0	0	0	No	Detects < RSL
Ethyl benzene		1/19	5%	0.06	0.06	0.05	3	700	1.5	0	2	0	No	Detects < RSL

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Table 2 Groundwater COPC Selection - Ebenezer Formation

Parameter	Surrogate [1]	Detection Frequency	% Detects	Min Detect (µg/L)	Max Detect (µg/L)	Min DL for ND (µg/L)	Max DL for ND (µg/L)	MCL (µg/L)	Res RSL [2] (µg/L)	# Detects > RSL	# DL [3] > RSL	# DL > MCL	COPC?	Basis
Isopropylbenzene		0/19	0%			0.05	2.5		45		0		No	No Detects, All DL < RSL
m&p-Xylene	(m-Xylene)	0/19	0%			0.1	5		19		0		No	No Detects, All DL < RSL
n-Butylbenzene		0/19	0%			0.05	2.5		100		0		No	No Detects, All DL < RSL
n-Propylbenzene		0/19	0%			0.054	3		66		0		No	No Detects, All DL < RSL
o-Xylene		0/19	0%			0.05	2.5		19		0		No	No Detects, All DL < RSL
p-Isopropyltoluene	Toluene	0/19	0%			0.05	2.5		110		0		No	No Detects, All DL < RSL
sec-Butylbenzene		0/19	0%			0.06	3		200		0		No	No Detects, All DL < RSL
Styrene		0/19	0%			0.05	2.5	100	120		0	0	No	No Detects, All DL < RSL
tert-Butylbenzene		0/19	0%			0.059	3.5		69		0		No	No Detects, All DL < RSL
Tetrachloroethene		0/19	0%			0.06	3	5	4.1		0	0	No	No Detects, All DL < RSL
Toluene		3/19	16%	0.09	2.2	0.07	3.5	1000	110	0	0	0	No	Detects < RSL
trans-1,2-Dichloroethene		0/19	0%			0.06	3	100	6.8		0	0	No	No Detects, All DL < RSL
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/19	0%			0.06	3		0.47		13		Qualitative	Not detected; DLs above RSLs
Trichloroethene		0/19	0%			0.06	3	5	0.28		13	0	No	Not detected; DLs below MCL
Trichlorofluoromethane		0/19	0%			0.05	2.5		520		0		No	No Detects, All DL < RSL
Vinyl chloride		0/19	0%			0.075	5	2	0.019		19	5	Qualitative	Not detected; DLs above RSLs
SVOCs														
1,2,3-Trichlorobenzene		0/19	0%			0.05	2.5		0.7		5		Qualitative	Not detected; DLs above RSLs
1,2,4-Trichlorobenzene		0/19	0%			0.06	3	70	0.4		13	0	No	Not detected; DLs below MCL
1,2-Dichlorobenzene		0/19	0%			0.06	3	600	30		0	0	No	No Detects, All DL < RSL
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/19	0%			0.06	3		30		0		No	No Detects, All DL < RSL
1,4-Dichlorobenzene		0/19	0%			0.07	3.5	75	0.48		13	0	No	Not detected; DLs below MCL
1-Methyl Naphthalene		9/19	47%	0.0042	0.7	0.0035	0.05		1.1	0	0		No	Detects < RSL
2-Methylnaphthalene		8/19	42%	0.0045	1.1	0.0023	0.1		3.6	0	0		No	Detects < RSL
Acenaphthene		0/19	0%			0.0044	0.05		53		0		No	No Detects, All DL < RSL
Acenaphthylene	Pyrene	0/19	0%			0.0034	0.05		12		0		No	No Detects, All DL < RSL
Anthracene		3/19	16%	0.031	0.032	0.0036	0.05		180	0	0		No	Detects < RSL
Benzo(a)anthracene		4/19	21%	0.0043	0.39	0.0026	0.05		0.03	1	5		**Yes**	Detects > RSL
Benzo(a)pyrene		3/19	16%	0.015	0.48	0.0043	0.05	0.2	0.025	2	5	0	**Yes**	Detects > RSL
Benzo(b)fluoranthene		3/19	16%	0.025	0.48	0.0041	0.05		0.25	1	0		**Yes**	Detects > RSL
Benzo(g,h,i)perylene	Pyrene	3/19	16%	0.015	0.54	0.0029	0.05		12	0	0		No	Detects < RSL
Benzo(k)fluoranthene		3/19	16%	0.011	0.49	0.003	0.05		2.5	0	0		No	Detects < RSL
Chrysene		3/19	16%	0.018	0.46	0.0034	0.05		25	0	0		No	Detects < RSL
Dibenzo(a,h)anthracene		1/19	5%	0.59	0.59	0.0025	0.1		0.025	1	5		**Yes**	Detects > RSL
Dibenzofuran		0/19	0%			0.0093	0.05		0.79		0		No	No Detects, All DL < RSL
Fluoranthene		4/19	21%	0.015	0.18	0.01	0.05		80	0	0		No	Detects < RSL
Fluorene		1/19	5%	0.01	0.01	0.0038	0.05		29	0	0		No	Detects < RSL
Hexachlorobutadiene		0/19	0%			0.07	3.5		0.14		13		Qualitative	Not detected; DLs above RSLs
Indeno(1,2,3-cd)pyrene		3/19	16%	0.012	0.64	0.0026	0.05		0.25	1	0		**Yes**	Detects > RSL
Naphthalene		6/19	32%	0.03	0.51	0.0038	0.2		0.12	1	5		**Yes**	Detects > RSL
Phenanthrene	Pyrene	4/19	21%	0.0089	0.062	0.005	0.2		12	0	0		No	Detects < RSL
Pyrene		4/19	21%	0.029	0.16	0.0053	0.05		12	0	0		No	Detects < RSL

Table 2 Groundwater COPC Selection - Ebenezer Formation

Parameter	Surrogate [1]	Detection Frequency	% Detects	Min Detect (µg/L)	Max Detect (µg/L)	Min DL for ND (µg/L)	Max DL for ND (µg/L)	MCL (µg/L)	Res RSL [2] (µg/L)	# Detects > RSL	# DL [3] > RSL	# DL > MCL	COPC?	Basis
Inorganics														
Aluminum		6/19	32%	32	4560	4	390		2000	1	0		Yes	Detects > RSL
Antimony		1/19	5%	0.11	0.11	0.02	8.1	6	0.78	0	6	5	No	Detects < RSL
Arsenic		15/18	83%	0.06	54	14	14	10	0.052	15	3	3	Yes	Detects > RSL
Barium		14/19	74%	9.36	259	15	15	2000	380	0	0	0	No	Detects < RSL
Beryllium		6/19	32%	0.03	0.443	0.004	2.4	4	2.5	0	0	0	No	Detects < RSL
Cadmium		1/19	5%	0.704	0.704	0.006	3	5	0.92	0	5	0	No	Detects < RSL
Calcium		18/19	95%	2700	447000	1500	1500						No	Essential nutrient
Chromium	Chromium, III	14/18	78%	0.33	110	0.21	0.21	100	2200	0	0	0	No	Detects < RSL
Chromium, VI [4]		3/10	30%	0.35	0.99	0.05	40		0.035	3	7		Yes	Detects > RSL
Cobalt		10/19	53%	0.019	0.42	0.15	3.1		0.6	0	5		No	Detects < RSL
Copper		11/19	58%	0.11	28	1.01	7.2	1300	80	0	0	0	No	Detects < RSL
Iron		17/19	89%	58	14600	460	460		1400	9	0		Yes	Detects > RSL
Lead		6/19	32%	0.037	3.37	0.2	1.4	15	15	0	0	0	No	Detects < RSL
Magnesium		14/19	74%	713	55300	210	210						No	Essential nutrient
Manganese		13/19	68%	4.2	1120	5.06	13		43	10	0		Yes	Detects > RSL
Mercury		16/18	89%	0.00214	25.2	0.00083	0.00083	2	0.063	11	0	0	Yes	Detects > RSL
Nickel		10/19	53%	0.06	46	2	12		0.083	9	9		Yes	Detects > RSL
Potassium		19/19	100%	870	170000								No	Essential nutrient
Selenium		5/19	26%	1.5	57.7	0.07	22.3	50	10	4	6	0	Yes	Detects > RSL
Silver		0/19	0%			0.005	85		9.4		1		No	< 5% detect / < 5% DL >RSL
Sodium		19/19	100%	13700	31100000								No	Essential nutrient
Thallium		2/19	11%	0.008	0.013	0.13	2.6	2	0.02	0	17	5	No	Detects < RSL
Vanadium		13/19	68%	12	520	0.5	8.6		8.6	13	0		Yes	Detects > RSL
Zinc		6/19	32%	0.6	30	8.08	120		600	0	0		No	Detects < RSL

1) Surrogates not in parenthases taken from the approved surrogate list included in the OU3 HHBRA.
2) Tapwater RSLs from EPA RSL Tables Nov 2020; non-carcinogens evaluated for HQ of 0.1
3) Number of non-detected results with detection limits above the RSL.
4) Hexavalent chromium results from 2012 sampling event

Table 3 Mixed Soil COPC Selection - CBA EU (0-5 ft-bgs)

Parameter	Surrogate	Detection Frequency	% Detects	Min Detect (mg/kg)	Max Detect (mg/kg)	Min DL for ND (mg/kg)	Max DL for ND (mg/kg)	Res RSL [2] (mg/kg)	# Detects > RSL	# DL [3] > RSL	COPC?	Basis
PCBs												
Aroclor-1016		0/33	0%			0.019	110	0.41		12	Qualitative	No Detects; DL > RSL
Aroclor-1221		0/33	0%			0.012	110	0.2		20	Qualitative	No Detects; DL > RSL
Aroclor-1232		0/33	0%			0.024	110	0.17		25	Qualitative	No Detects; DL > RSL
Aroclor-1242		0/33	0%			0.012	110	0.23		14	Qualitative	No Detects; DL > RSL
Aroclor-1248		0/33	0%			0.0072	110	0.23		14	Qualitative	No Detects; DL > RSL
Aroclor-1254		7/33	21%	0.14	2.8	0.0088	110	0.12	7	18	**Yes**	Detects > RSL
Aroclor-1260		6/33	18%	0.13	1.3	0.013	110	0.24	4	17	**Yes**	Detects > RSL
Aroclor-1268	(Aroclor-1254)	21/33	64%	0.047	350	0.0066	2.66	0.12	18	8	**Yes**	Detects > RSL
PAHs												
1-Methyl Naphthalene		1/3	33%	0.0084	0.0084	0.35	0.36	18	0	0	No	Detects < RSL
2-Methylnaphthalene		1/13	8%	0.013	0.013	0.35	8.9	24	0	0	No	Detects < RSL
Acenaphthene		0/13	0%			0.0053	8.9	360		0	No	No Detects, All DL < RSL
Acenaphthylene	Pyrene	0/13	0%			0.0051	8.9	180		0	No	No Detects, All DL < RSL
Anthracene		0/13	0%			0.0056	8.9	1800		0	No	No Detects, All DL < RSL
Benzo(a)anthracene		2/13	15%	0.017	0.96	0.35	8.9	1.1	0	9	No	Detects < RSL
Benzo(a)pyrene		2/13	15%	0.022	0.37	0.35	8.9	0.11	1	11	**Yes**	Detects > RSL
Benzo(b)fluoranthene		1/3	33%	0.023	0.023	0.35	0.36	1.1	0	0	No	Detects < RSL
Benzo(b/k)fluoranthene	(Benzo(b)fluoranthene)	1/10	10%	1.3	1.3	6	8.9	1.1	1	9	**Yes**	Detects > RSL
Benzo(g,h,i)perylene	Pyrene	2/13	15%	0.062	0.76	0.35	8.9	180	0	0	No	Detects < RSL
Benzo(k)fluoranthene		1/3	33%	0.015	0.015	0.35	0.36	11	0	0	No	Detects < RSL
Chrysene		1/13	8%	0.023	0.023	0.35	8.9	110	0	0	No	Detects < RSL
Dibenzo(a,h)anthracene		1/13	8%	0.012	0.012	0.35	8.9	0.11	0	12	No	Detects < RSL
Fluoranthene		2/13	15%	0.023	1.8	0.35	8.9	240	0	0	No	Detects < RSL
Fluorene		0/13	0%			0.0056	8.9	240		0	No	No Detects, All DL < RSL
Indeno(1,2,3-cd)pyrene		2/13	15%	0.02	0.38	0.35	8.9	1.1	0	10	No	Detects < RSL
Naphthalene		1/13	8%	0.0074	0.0074	0.35	8.9	2	0	10	No	Detects < RSL
Phenanthrene	Pyrene	1/13	8%	0.016	0.016	0.35	8.9	180	0	0	No	Detects < RSL
Pyrene		3/13	23%	0.028	1.8	0.35	8.9	180	0	0	No	Detects < RSL
SVOCs												
1,2,4-Trichlorobenzene		0/10	0%			6	8.9	5.8		10	Qualitative	No Detects; DL > RSL
1,2-Dichlorobenzene		0/10	0%			0.034	0.11	180		0	No	No Detects, All DL < RSL
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/10	0%			0.034	0.11	180		0	No	No Detects, All DL < RSL
1,4-Dichlorobenzene		0/10	0%			0.034	0.11	2.6		0	No	No Detects, All DL < RSL
2,2'-Chloroisopropylether		0/10	0%			6	8.9				No	No Detects, No RSL
2,3,4,6-Tetrachlorophenol		0/10	0%			6	8.9	190		0	No	No Detects, All DL < RSL
2,4,5-Trichlorophenol		0/10	0%			6	8.9	630		0	No	No Detects, All DL < RSL
2,4,6-Trichlorophenol		0/10	0%			6	8.9	6.3		9	Qualitative	No Detects; DL > RSL
2,4-Dichlorophenol		0/10	0%			6	8.9	19		0	No	No Detects, All DL < RSL
2,4-Dimethylphenol		0/10	0%			6	8.9	130		0	No	No Detects, All DL < RSL
2,4-Dinitrophenol		0/10	0%			12	18	13		9	Qualitative	No Detects; DL > RSL
2,6-Dinitrotoluene		0/10	0%			6	8.9	0.36		10	Qualitative	No Detects; DL > RSL
2-Chloronaphthalene		0/10	0%			6	8.9	480		0	No	No Detects, All DL < RSL

Table 3 Mixed Soil COPC Selection - CBA EU (0-5 ft-bgs)

Parameter	Surrogate	Detection Frequency	% Detects	Min Detect (mg/kg)	Max Detect (mg/kg)	Min DL for ND (mg/kg)	Max DL for ND (mg/kg)	Res RSL [2] (mg/kg)	# Detects > RSL	# DL [3] > RSL	COPC?	Basis
2-Chlorophenol		0/10	0%			6	8.9	39		0	No	No Detects, All DL < RSL
2-Methylphenol		0/10	0%			6	8.9	320		0	No	No Detects, All DL < RSL
2-Nitroaniline		0/10	0%			6	8.9	63		0	No	No Detects, All DL < RSL
2-Nitrophenol	2,4-Dinitrophenol	0/10	0%			6	8.9	13		0	No	No Detects, All DL < RSL
3,3'-Dichlorobenzidine		0/10	0%			6	8.9	1.2		10	Qualitative	No Detects; DL > RSL
3/4-Methylphenol	3-Methylphenol	0/10	0%			6	8.9	320		0	No	No Detects, All DL < RSL
3-Nitroaniline		0/10	0%			6	8.9				No	No Detects, No RSL
4,6-Dinitro-2-methylphenol		0/10	0%			12	18	0.51		10	Qualitative	No Detects; DL > RSL
4-Bromophenyl-phenylether		0/10	0%			6	8.9				No	No Detects, No RSL
4-Chloro-3-methylphenol		0/10	0%			6	8.9	630		0	No	No Detects, All DL < RSL
4-Chloroaniline		0/10	0%			6	8.9	2.7		10	Qualitative	No Detects; DL > RSL
4-Chlorophenyl-phenylether	Methoxychlor	0/10	0%			6	8.9	32		0	No	No Detects, All DL < RSL
4-Nitroaniline		0/10	0%			6	8.9	25		0	No	No Detects, All DL < RSL
4-Nitrophenol	2,4-Dinitrophenol	0/10	0%			12	18	13		9	Qualitative	No Detects; DL > RSL
bis(2-Chloroethoxy) methane		0/10	0%			6	8.9	19		0	No	No Detects, All DL < RSL
bis(2-Chloroethyl) ether		0/10	0%			6	8.9	0.23		10	Qualitative	No Detects; DL > RSL
bis(2-Ethylhexyl) phthalate		0/10	0%			6	8.9	39		0	No	No Detects, All DL < RSL
Butylbenzylphthalate		0/10	0%			6	8.9	290		0	No	No Detects, All DL < RSL
Carbazole		0/10	0%			6	8.9				No	No Detects, No RSL
Cyclohexanone		0/9	0%			6	8.9	2800		0	No	No Detects, All DL < RSL
Dibenzofuran		0/11	0%			0.0026	8.9	7.8		4	Qualitative	No Detects; DL > RSL
Diethylphthalate		0/10	0%			6	8.9	5100		0	No	No Detects, All DL < RSL
Dimethylphthalate	<<subchronic>>	0/10	0%			6	8.9				No	No Detects, No RSL
Di-n-butylphthalate		0/10	0%			6	8.9	630		0	No	No Detects, All DL < RSL
Di-n-octylphthalate		0/10	0%			6	8.9	63		0	No	No Detects, All DL < RSL
Hexachlorobenzene		0/10	0%			6	8.9	0.21		10	Qualitative	No Detects; DL > RSL
Hexachlorobutadiene		0/10	0%			6	8.9	1.2		10	Qualitative	No Detects; DL > RSL
Hexachlorocyclopentadiene		0/10	0%			6	8.9	0.18		10	Qualitative	No Detects; DL > RSL
Hexachloroethane		0/10	0%			6	8.9	1.8		10	Qualitative	No Detects; DL > RSL
Isophorone		0/10	0%			6	8.9	570		0	No	No Detects, All DL < RSL
Nitrobenzene		0/10	0%			6	8.9	5.1		10	Qualitative	No Detects; DL > RSL
N-Nitroso-di-n-propylamine		0/10	0%			6	8.9	0.078		10	Qualitative	No Detects; DL > RSL
N-Nitrosodiphenylamine/Diphenylamine		0/10	0%			6	8.9	110		0	No	No Detects, All DL < RSL
Pentachlorophenol		0/10	0%			12	18	1		10	Qualitative	No Detects; DL > RSL
Phenol		0/10	0%			6	8.9	1900		0	No	No Detects, All DL < RSL
Pyridine		0/9	0%			6	8.9	7.8		4	Qualitative	No Detects; DL > RSL
VOCs												
1,1,1,2-Tetrachloroethane		0/2	0%			0.034	0.064	2		0	No	No Detects, All DL < RSL
1,1,1-Trichloroethane		0/10	0%			0.034	0.11	810		0	No	No Detects, All DL < RSL
1,1,2,2-Tetrachloroethane		0/10	0%			0.034	0.11	0.6		0	No	No Detects, All DL < RSL
1,1,2-Trichloroethane		0/10	0%			0.034	0.11	0.15		0	No	No Detects, All DL < RSL
1,1-Dichloroethane		0/10	0%			0.034	0.11	3.6		0	No	No Detects, All DL < RSL
1,1-Dichloroethene		0/10	0%			0.034	0.11	23		0	No	No Detects, All DL < RSL

Table 3 Mixed Soil COPC Selection - CBA EU (0-5 ft-bgs)

Parameter	Surrogate	Detection Frequency	% Detects	Min Detect (mg/kg)	Max Detect (mg/kg)	Min DL for ND (mg/kg)	Max DL for ND (mg/kg)	Res RSL [2] (mg/kg)	# Detects > RSL	# DL [3] > RSL	COPC?	Basis
1,1-Dichloropropene	1,3-Dichloropropene	0/9	0%			0.034	0.11	1.8		0	No	No Detects, All DL < RSL
1,2,3-Trichloropropane		0/9	0%			0.034	0.11	0.0051		9	Qualitative	No Detects; DL > RSL
1,2,4-Trimethylbenzene		0/1	0%			0.06	0.06	30		0	No	No Detects, All DL < RSL
1,2-Dichloroethane		0/10	0%			0.034	0.11	0.46		0	No	No Detects, All DL < RSL
1,2-Dichloropropane		0/10	0%			0.034	0.11	1.6		0	No	No Detects, All DL < RSL
1,3,5-Trimethylbenzene		0/1	0%			0.06	0.06	27		0	No	No Detects, All DL < RSL
1,3-Dichloropropane		0/9	0%			0.034	0.11	160		0	No	No Detects, All DL < RSL
2,2-Dichloropropane	1,3-Dichloropropane	0/9	0%			0.034	0.11	160		0	No	No Detects, All DL < RSL
2-Butanone (MEK)		0/9	0%			0.34	1.1	2700		0	No	No Detects, All DL < RSL
2-Chloroethyl vinyl ether		0/1	0%			0.06	0.06				No	No Detects, No RSL
2-Chlorotoluene		0/9	0%			0.034	0.11	160		0	No	No Detects, All DL < RSL
2-Hexanone		0/9	0%			0.085	0.27	20		0	No	No Detects, All DL < RSL
4-Chlorotoluene		0/9	0%			0.034	0.11	160		0	No	No Detects, All DL < RSL
4-Methyl-2-pentanone		0/9	0%			0.085	0.27	3300		0	No	No Detects, All DL < RSL
Acetone		1/9	11%	0.35	0.35	0.34	1.1	6100	0	0	No	Detects < RSL
Benzene		0/10	0%			0.034	0.11	1.2		0	No	No Detects, All DL < RSL
Bromobenzene		0/9	0%			0.034	0.11	29		0	No	No Detects, All DL < RSL
Bromochloromethane		0/9	0%			0.034	0.11	15		0	No	No Detects, All DL < RSL
Bromodichloromethane		0/10	0%			0.034	0.11	0.29		0	No	No Detects, All DL < RSL
Bromoform		0/10	0%			0.034	0.11	19		0	No	No Detects, All DL < RSL
Bromomethane		0/10	0%			0.034	0.11	0.68		0	No	No Detects, All DL < RSL
Carbon disulfide		0/9	0%			0.085	0.27	77		0	No	No Detects, All DL < RSL
Carbon tetrachloride		0/10	0%			0.034	0.11	0.65		0	No	No Detects, All DL < RSL
Chlorobenzene		0/10	0%			0.034	0.11	28		0	No	No Detects, All DL < RSL
Chloroethane		0/10	0%			0.034	0.11	1400		0	No	No Detects, All DL < RSL
Chloroform		0/10	0%			0.034	0.11	0.32		0	No	No Detects, All DL < RSL
Chloromethane		0/10	0%			0.034	0.11	11		0	No	No Detects, All DL < RSL
cis-1,2-Dichloroethene		0/10	0%			0.034	0.11	16		0	No	No Detects, All DL < RSL
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/10	0%			0.034	0.11	1.8		0	No	No Detects, All DL < RSL
Dibromochloromethane		0/10	0%			0.034	0.11	8.3		0	No	No Detects, All DL < RSL
Dibromomethane		0/9	0%			0.034	0.11	2.4		0	No	No Detects, All DL < RSL
Dichlorodifluoromethane		0/1	0%			0.06	0.06	8.7		0	No	No Detects, All DL < RSL
Dichloromethane (Methylene chloride)		0/10	0%			0.034	0.18	35		0	No	No Detects, All DL < RSL
Ethyl benzene		0/10	0%			0.034	0.11	5.8		0	No	No Detects, All DL < RSL
Isopropylbenzene		1/2	50%	0.0094	0.0094	0.06	0.06	190	0	0	No	Detects < RSL
m&p-Xylene	(m-Xylene)	0/1	0%			0.06	0.06	55		0	No	No Detects, All DL < RSL
n-Butylbenzene		0/1	0%			0.06	0.06	390		0	No	No Detects, All DL < RSL
n-Propylbenzene		0/1	0%			0.06	0.06	380		0	No	No Detects, All DL < RSL
o-Xylene		0/10	0%			0.034	0.11	65		0	No	No Detects, All DL < RSL
p-Isopropyltoluene	Toluene	0/1	0%			0.06	0.06	490		0	No	No Detects, All DL < RSL
sec-Butylbenzene		0/1	0%			0.06	0.06	780		0	No	No Detects, All DL < RSL
Styrene		0/10	0%			0.034	0.11	600		0	No	No Detects, All DL < RSL
tert-Butylbenzene		0/1	0%			0.06	0.06	780		0	No	No Detects, All DL < RSL

Table 3 Mixed Soil COPC Selection - CBA EU (0-5 ft-bgs)

Parameter	Surrogate	Detection Frequency	% Detects	Min Detect (mg/kg)	Max Detect (mg/kg)	Min DL for ND (mg/kg)	Max DL for ND (mg/kg)	Res RSL [2] (mg/kg)	# Detects > RSL	# DL [3] > RSL	COPC?	Basis
Tetrachloroethene		0/10	0%			0.034	0.11	8.1		0	No	No Detects, All DL < RSL
Toluene		0/10	0%			0.034	0.11	490		0	No	No Detects, All DL < RSL
trans-1,2-Dichloroethene		0/10	0%			0.034	0.11	7		0	No	No Detects, All DL < RSL
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/10	0%			0.034	0.11	1.8		0	No	No Detects, All DL < RSL
Trichloroethene		0/10	0%			0.034	0.11	0.41		0	No	No Detects, All DL < RSL
Trichlorofluoromethane		0/10	0%			0.034	0.11	2300		0	No	No Detects, All DL < RSL
Vinyl chloride		0/10	0%			0.034	0.11	0.059		6	Qualitative	No Detects; DL > RSL
Xylenes (unspecified)		0/9	0%			0.034	0.11	58		0	No	No Detects, All DL < RSL
Metals												
Aluminum		2/2	100%	1680	2200			7700	0		No	Detects < RSL
Antimony		0/2	0%			0.149	6	3.1		1	Qualitative	No Detects; DL > RSL
Arsenic		0/10	0%			0.445	6	0.68		9	Qualitative	No Detects; DL > RSL
Barium		10/10	100%	4.9	14			1500	0		No	Detects < RSL
Beryllium		0/2	0%			0.235	1	16		0	No	No Detects, All DL < RSL
Cadmium		0/10	0%			0.09	1	7.1		0	No	No Detects, All DL < RSL
Calcium		2/2	100%	387	15000						No	Essential Nutrient
Chromium	Chromium, III	10/10	100%	2.6	5.5			12000	0		No	Detects < RSL
Chromium	Chromium, VI	10/10	100%	2.6	5.5			0.3	10		Yes	Detects > RSL
Cobalt		1/2	50%	0.185	0.185	2	2	2.3	0	0	No	Detects < RSL
Copper		2/2	100%	6.47	8.7			310	0		No	Detects < RSL
Iron		2/2	100%	689	13000			5500	1		Yes	Detects > RSL
lead		22/22	100%	2.5	407			400	1		Yes	Detects > RSL
Magnesium		2/2	100%	94.9	790						No	Essential Nutrient
Manganese		2/2	100%	6.86	69			180	0		No	Detects < RSL
Mercury		118/120	98%	0.02	3700	0.6	0.66	1.1	101	0	Yes	Detects > RSL
Molybdenum		0/1	0%			2	2	39		0	No	No Detects, All DL < RSL
Nickel		2/2	100%	1.31	4.1			0.76	2		Yes	Detects > RSL
Potassium		1/2	50%	87.7	87.7	400	400				No	Essential Nutrient
Selenium		0/10	0%			0.302	8	39		0	No	No Detects, All DL < RSL
Silver		1/10	10%	0.194	0.194	0.5	2	39	0	0	No	Detects < RSL
Sodium		2/2	100%	64	1300						No	Essential Nutrient
Strontium		1/1	100%	250	250			4700	0		No	Detects < RSL
Tellurium		0/1	0%			10	10				No	No Detects, No RSL
Thallium		0/2	0%			0.12	20	0.078		2	Qualitative	No Detects; DL > RSL
Tin		0/1	0%			6	6	4700		0	No	No Detects, All DL < RSL
Titanium		1/1	100%	63	63						No	No RSL, 2 or Fewer Samples
Vanadium		2/2	100%	1.31	8.9			39	0		No	Detects < RSL
Yttrium		0/1	0%			2	2				No	No Detects, No RSL
Zinc		2/2	100%	9.15	100			2300	0		No	Detects < RSL

1) Surrogates not in parenthases taken from the approved surrogate list included in the OU3 HHBRA.
2) Residential RSLs from EPA RSL Tables Nov 2020; non-carcinogens evaluated for HQ of 0.1
3) Number of non-detected results with detection limits above the RSL.

Table 4 Surface Soil COPC Selection - CBA EU (0-2 ft-bgs)

Parameter	Detection Frequency	% Detects	Min Detect (mg/kg)	Max Detect (mg/kg)	Min DL for ND (mg/kg)	Max DL for ND (mg/kg)	Res RSL[1] (mg/kg)	# Detects > RSL	# DL > RSL	COPC?	Basis
Mercury	7/7	100%	4.2	300			1.1	7		Yes	Detects > RSL

1) Residential RSLs from EPA RSL Tables Nov 2020; non-carcinogens evaluated for HQ of 0.1

Attachment A
CBA Dataset

ATTACHMENT A
CBA DATASET

Introduction

The area of interest for the soil risk evaluation is the area including the cell building area ("CBA") that was excluded from the OU3 HHBRA. This area is the CBA Exposure Unit ("EU"). The CBA EU (shown on Figure A-1) is slightly larger than the area where the soil cover was placed.

Based on comments from the EPA, the dataset to be used in the OU2 HHBRA was reevaluated. The sample depths of historical data were adjusted to account for the soil cover and/or concrete slabs that are present over the soil, thus increasing the distance from the ground surface to where the original samples were collected. In risk assessments, it is assumed that different receptors have potential exposure to soil based on the depth of the soil below ground surface (*e.g.,* Industrial Workers are assumed to have exposure to surface soil, which is from the ground surface to two feet below the ground surface). Accordingly, the datasets used in a risk assessment are based on depth intervals. Soil data have been collected in the cell CBA from 1994 to 2019. However, a clean soil cover was placed over the CBA in 1996/1997. Additionally, in some areas (building footprints) the soil cover was placed over concrete slabs. Thus, the depths below the ground surface where soil samples were collected prior to the cover are located at different depths now that a cover is present. Accordingly, the sample depths for samples collected prior to installation of the soil cover were adjusted to reflect the post-cover condition today. A summary of the process that was used to make this adjustment is presented below.

Soil Depth Adjustments

A topographic contour of the site from 1994 was available as an AutoCad file. This file was brought into ArcGIS and georectified in order to utilize the Georgia state plane coordinate system, which is the coordinate system used for designating the locations of soil samples collected at the site. Once positioned correctly, the topographic contours were manually adjusted to close the polylines so that there were not open breaks where labels obscured the original contours. The next step was to use the ArcGIS software to create a raster file interpolation based on the contours. Raster files make it possible to estimate a ground surface elevation at any location within the raster area.

A GIS shapefile was available showing the topographic contours of the site in 1997 after construction of the soil cover. This shapefile was used to create another raster file interpolation of the ground surface in 1997.

Figure A-2 shows the raster interpolations for 1994 and 1997. The ArcGIS software was used to find the difference in elevation between the 1994 and 1997 rasters. This elevation difference represents the estimated soil cover thickness in the CBA. The result is shown on Figure A-3. Approximately 14% of the CBA EU has less than one foot of cover soil.

A file of all the soil sample locations in the CBA area was imported into ArcGIS. The software was used to assign the estimated soil cover thickness to each sample location. Figure A-3 shows the locations of soil samples collected prior to the cover and the estimated soil cover thickness applied at each location.

Boring logs from sampling that was conducted in 2018 were reviewed to determine where concrete slabs were encountered and the depths of those slabs. This information was used to estimate the locations of the slabs in the CBA (Figure A-4). The pre-cover soil sample locations were added to this figure to determine where soil depths should be adjusted to incorporate the concrete slabs.

The resulting estimated soil cover and concrete slab thicknesses were then imported into the site database. The original depths assigned to each soil sample were archived within the database as separate fields. For the pre-cover soil samples, the cover thickness and concrete slab thickness were added to the database table and the depth designations were changed by adding the cover thickness to both the start depth ("D1") and the end depth ("D2"). For example, if at a location the original pre-cover sample depth interval was 4-5 ft (D1 = 4 and D2 = 5) and the cover thickness at this location was estimated to be 2 ft and concrete slab of 8 inches, then the revised depths were changed to 6.67 ft (D1) and 7.67 ft (D2). Table A-1 shows the depth adjustments for the soil samples collected prior to installation of the cover.

CBA HHBRA Dataset

The site database was queried to determine the sample results that should be included in the OU2-CBA HHBRA. ArcGIS was used to determine which historical soil locations are located within the CBA EU. This information was imported into the database. A query was created to extract the results for just these samples in the CBA EU. The query also included conditions to limit the soil depths in keeping with the procedure used in the OU3 HHBRA. Specifically, a $D1 < 5$ and a $D2 \leq 6$. (Note that as discussed in the main text of this letter, the COPC selection process was conducted for the mixed soil horizon (0-5 ft bgs) to be representative of both the surface soil and mixed soil horizons for the Excavation Worker. The surface soil for the other receptors is a subset of this dataset.) Duplicate results (*e.g.*, field duplicates) and data addressed during site removal activities (stockpile samples and other data marked as "removed") were also excluded. The resulting samples to be used in the HHBRA are shown in Table A-2 and on Figure A-5. These are the samples included in the COPC screening presented in Attachment B.

Topography (1997)

CBA Exposure Unit

CBA Exposure Unit
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No. A-1

CBA Exsposure Unit

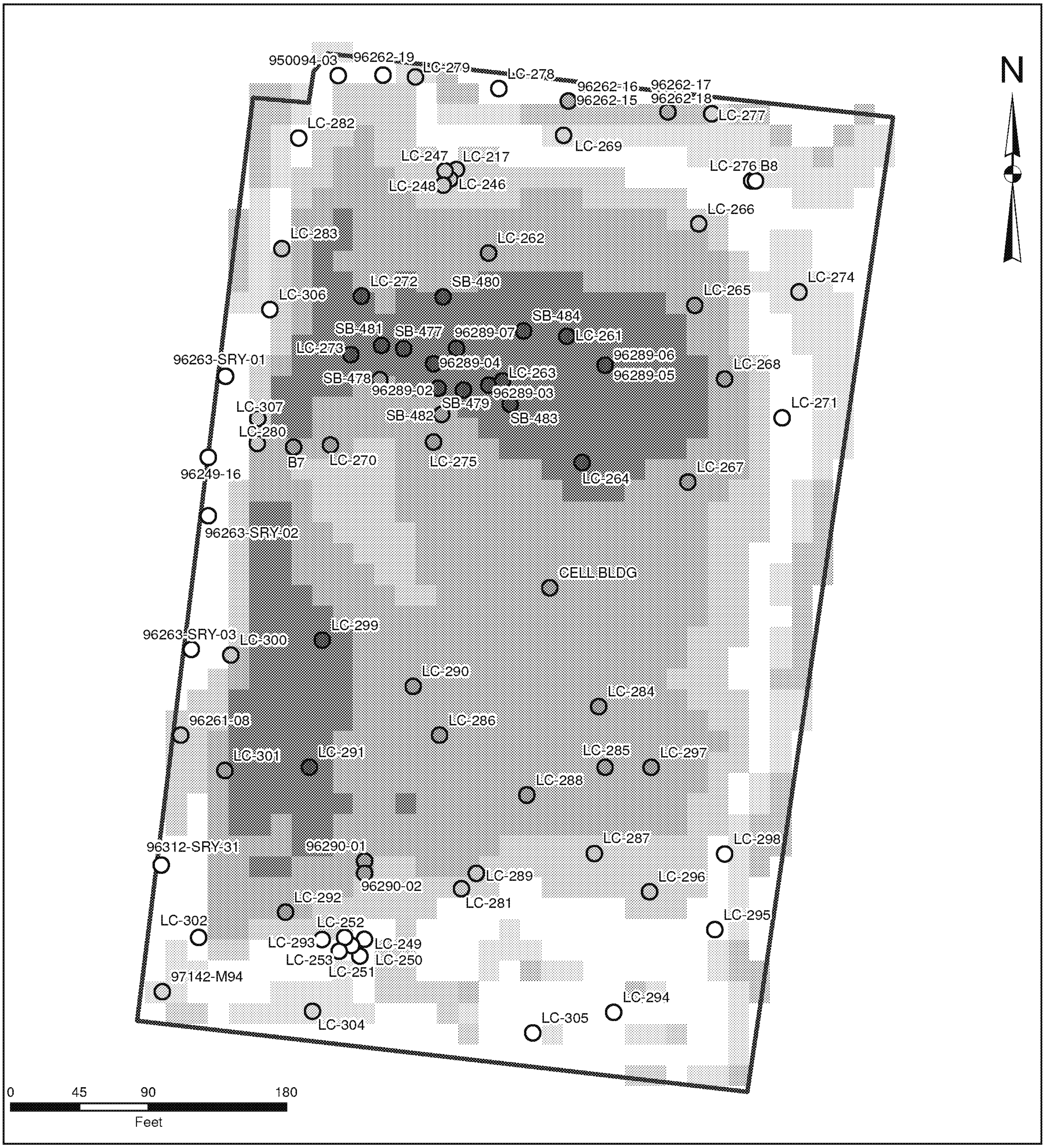
Ground Surface Elevation (ft)

- <0.5 ft
- 0.5 - 5
- 5 - 10
- 10 - 11
- 11 - 12
- 12 - 13
- 13 - 14
- 14 - 15
- 15 - 20
- > 20

Ground Surface Interpolations
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No. A-2



CBA Exposure Unit

Elevation Difference (ft)

- 0
- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2.- 2.5
- > 2.5

Soil Samples (pre-soil cover)

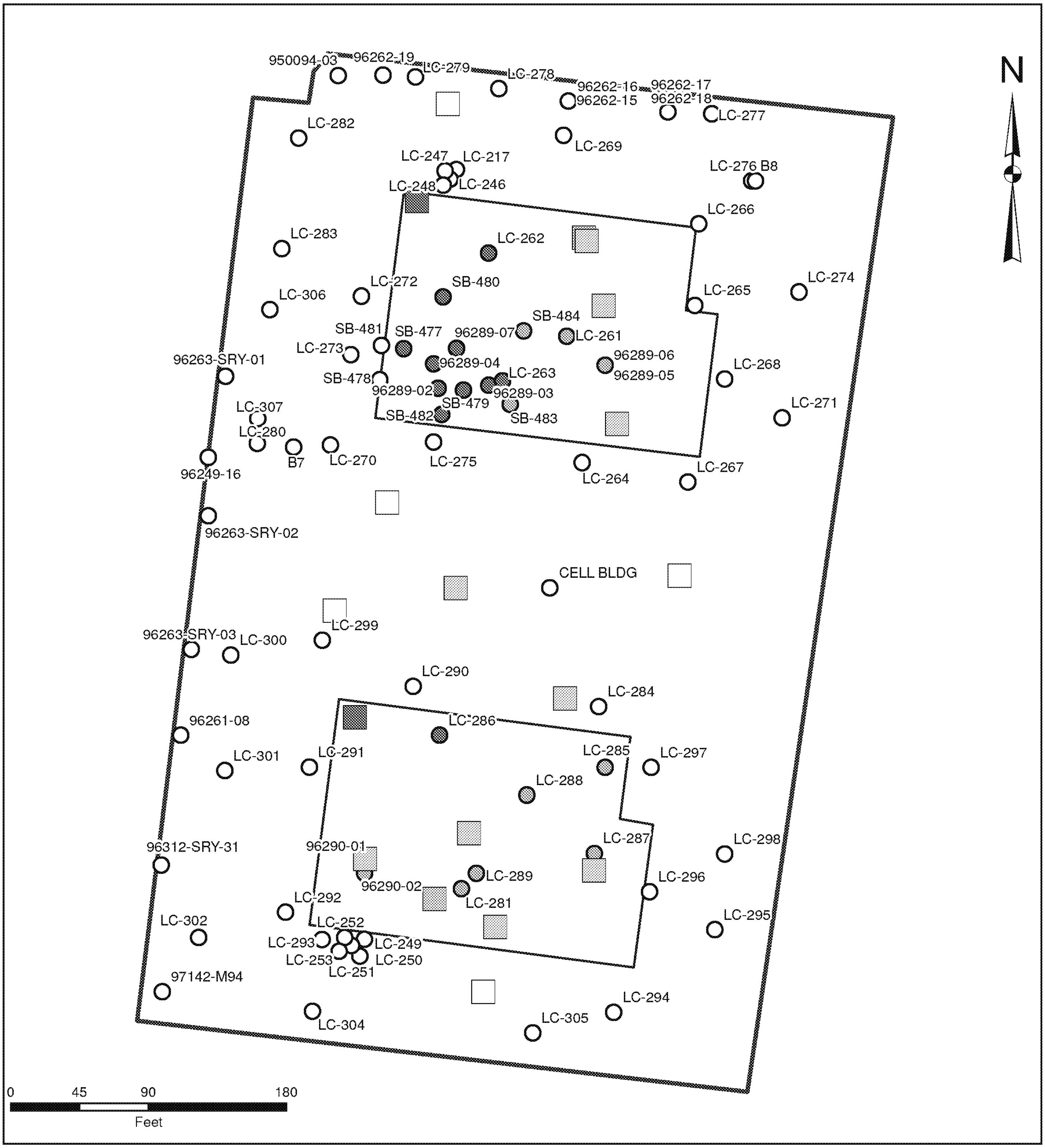
Depth Adjustment

- None
- < 0.5 ft
- 0.5 - 1 ft
- 1 -- 1.5 ft
- 1.5 - 2 ft
- 2 - 2.5 ft
- > 2.5 ft

Soil Cover Thickness
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No. A-3



CBA Exposure Unit

Cell Building Outlines

Locations where two 8" slabs observed

Locations where one 8" slab observed

Locations where no slab observed

Soil Samples (pre-soil cover)

Assumed Concrete Thickness

None

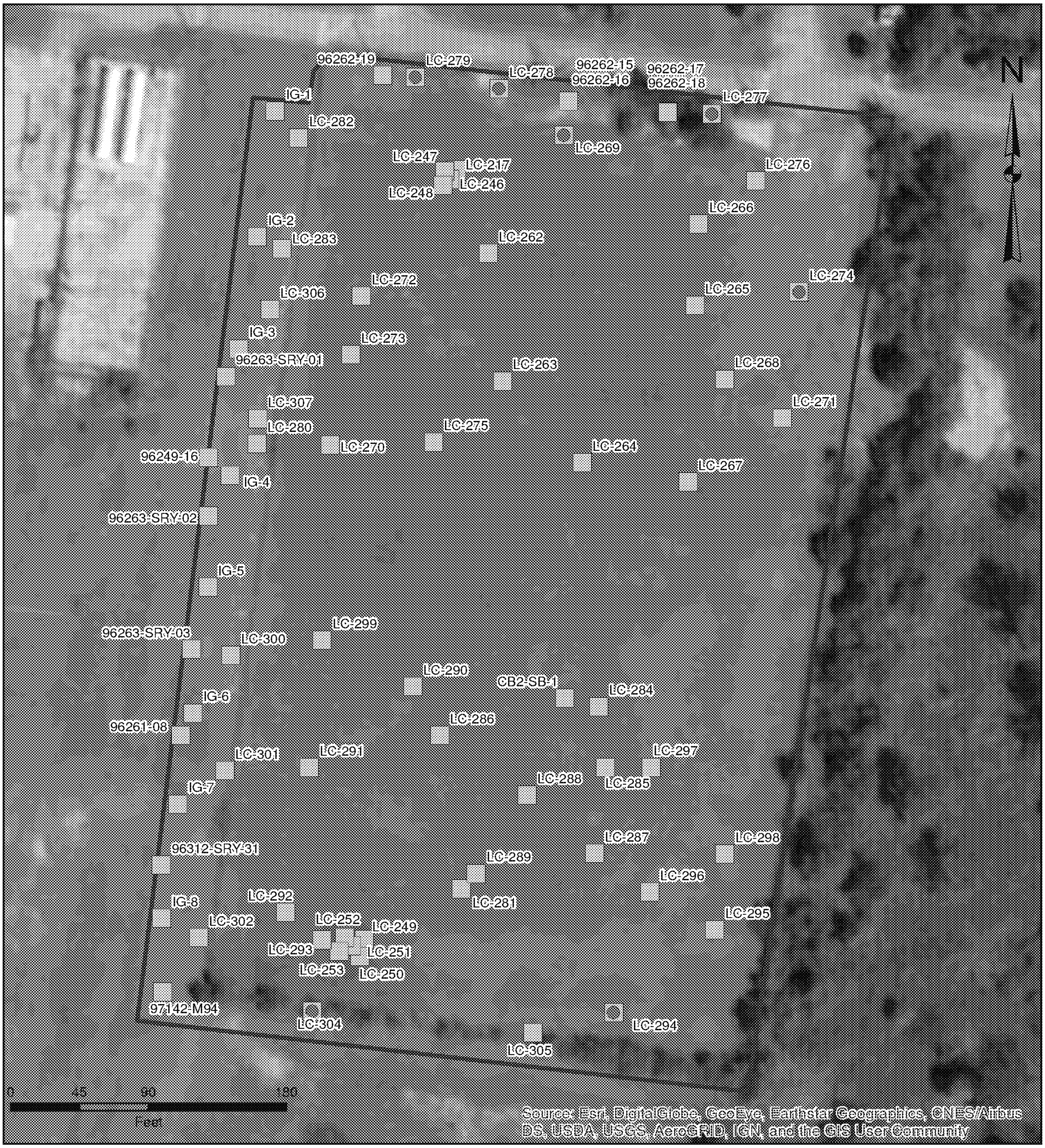
8"

16"

Concrete Slab Thickness
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No. A-4



Surface Soil (0-2 ft)

Mixed Soil Samples (0-5 ft)

CBA Exposure Unit

Historical Soil Samples to be Included in the HHBRA
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No. A-5

Table A-1. Soil Depth Changes for Samples Collected Prior to the CBA Soil Cover

Location	Sample Date	Original D1 (ft)	Original D2 (ft)	Soil Cap Thickness (ft)	Concrete Thickness (ft)	Total Depth Change (ft)	New D1 (ft)	New D2 (ft)
96249-16	9/5/1996	2.5	3.5				3.8	4.8
96261-08	9/17/1996	0	1	1.6		1.58	1.6	2.6
96262-15	9/18/1996	2	3	0.04		0.04	2.0	3.0
96262-16	9/18/1996	3	4	0.04		0.04	3.0	4.0
96262-17	9/18/1996	2	3	0.1		0.08	2.1	3.1
96262-18	9/18/1996	3	4	0.1		0.08	3.1	4.1
96262-19	9/18/1996	2	2.1				3.1	3.2
96263-SRY-01	9/19/1996	0	1.5	1.2		1.18	1.2	2.7
96263-SRY-02	9/19/1996	0	3	1.4		1.38	1.4	4.4
96263-SRY-03	9/19/1996	0	2.5	1.4		1.38	1.4	3.9
96289-02	10/15/1996	2	3	2.6	0.66	3.23	5.2	6.2
96289-03	10/15/1996	2	3	2.7	0.66	3.41	5.4	6.4
96289-04	10/15/1996	2	3	2.6	0.66	3.29	5.3	6.3
96289-05	10/15/1996	2	3	2.8	1.33	4.14	6.1	7.1
96289-06	10/15/1996	3	4	2.8	1.33	4.14	7.1	8.1
96289-07	10/15/1996	3	3.5	2.7	0.66	3.34	6.3	6.8
96290-01	10/16/1996	2	3	2.1	1.33	3.44	5.4	6.4
96290-02	10/16/1996	2	3	2.0	1.33	3.34	5.3	6.3
96312-SRY-31	11/7/1996	0	3.25	1.5		1.50	1.5	4.7
97142-M94	5/22/1997	0	4.5	0.9		0.88	0.9	5.4
B7	12/15/1994	15	15	2.4		2.37	17.4	17.4
B7	12/15/1994	20	20	2.4		2.37	22.4	22.4
B7	12/15/1994	40	40	2.4		2.37	42.4	42.4
B8	12/15/1994	10	10	1.0		1.04	11.0	11.0
B8	12/15/1994	20	20	1.0		1.04	21.0	21.0
B8	12/15/1994	40	40	1.0		1.04	41.0	41.0
LC-217	10/15/1994	0	1	1.6		1.6	1.6	2.6
LC-246	10/15/1994	0	1	1.7		1.7	1.7	2.7
LC-246	10/15/1994	2	3	1.7		1.7	3.7	4.7
LC-247	10/15/1994	0	1	1.6		1.6	1.6	2.6
LC-247	10/15/1994	2	3	1.6		1.6	3.6	4.6
LC-247	10/15/1994	4	5	1.6		1.6	5.6	6.6
LC-248	10/15/1994	0	1	1.8		1.8	1.8	2.8
LC-249	10/15/1994	0	1	1.3		1.3	1.3	2.3
LC-249	10/15/1994	2	3	1.3		1.3	3.3	4.3
LC-250	10/15/1994	0	1	1.2		1.2	1.2	2.2
LC-250	10/15/1994	2	3	1.2		1.2	3.2	4.2
LC-251	10/18/1994	0	1	1.3		1.3	1.3	2.3
LC-251	10/18/1994	2	3	1.3		1.3	3.3	4.3
LC-252	10/18/1994	0	1	1.4		1.4	1.4	2.4
LC-252	10/18/1994	2	3	1.4		1.4	3.4	4.4
LC-252	10/18/1994	4	5	1.4		1.4	5.4	6.4
LC-253	10/18/1994	0	1	1.2		1.2	1.2	2.2
LC-253	10/18/1994	2	3	1.2		1.2	3.2	4.2
LC-261	10/13/1994	1.5	2.5	2.7	1.33	4.0	5.5	6.5
LC-261	10/13/1994	3.5	4.5	2.7	1.33	4.0	7.5	8.5
LC-262	10/14/1994	1.5	2.5	2.4	0.66	3.0	4.5	5.5
LC-262	10/14/1994	3.5	4.5	2.4	0.66	3.0	6.5	7.5
LC-263	10/14/1994	1	2	2.8	0.66	3.4	4.4	5.4
LC-263	10/14/1994	3	4	2.8	0.66	3.4	6.4	7.4

Table A-1. Soil Depth Changes for Samples Collected Prior to the CBA Soil Cover

Location	Sample Date	Original D1 (ft)	Original D2 (ft)	Soil Cap Thickness (ft)	Concrete Thickness (ft)	Total Depth Change (ft)	New D1 (ft)	New D2 (ft)
LC-264	10/13/1994	0	1	2.6		2.6	2.6	3.6
LC-264	10/13/1994	2	3	2.6		2.6	4.6	5.6
LC-264	10/13/1994	3	3	2.6		2.6	5.6	5.6
LC-265	10/14/1994	0	1	2.4		2.4	2.4	3.4
LC-265	10/14/1994	2	3	2.4		2.4	4.4	5.4
LC-266	10/14/1994	0	1	1.8		1.8	1.8	2.8
LC-266	10/14/1994	2	3	1.8		1.8	3.8	4.8
LC-266	10/14/1994	4	5	1.8		1.8	5.8	6.8
LC-267	10/14/1994	0	1	2.3		2.3	2.3	3.3
LC-267	10/14/1994	2	3	2.3		2.3	4.3	5.3
LC-268	10/15/1994	0	1	2.4		2.4	2.4	3.4
LC-268	10/15/1994	2	3	2.4		2.4	4.4	5.4
LC-269	10/18/1994	0	1	1.0		1.0	1.0	2.0
LC-269	10/18/1994	2	3	1.0		1.0	3.0	4.0
LC-270	10/15/1994	0	1	2.1		2.1	2.1	3.1
LC-270	10/15/1994	2	3	2.1		2.1	4.1	5.1
LC-270	10/15/1994	4	5	2.1		2.1	6.1	7.1
LC-271	10/15/1994	0	1	1.4		1.4	1.4	2.4
LC-271	10/15/1994	2	3	1.4		1.4	3.4	4.4
LC-272	10/18/1994	1	2	2.6		2.6	3.6	4.6
LC-272	10/18/1994	3	4	2.6		2.6	5.6	6.6
LC-273	10/18/1994	1	2	2.7		2.7	3.7	4.7
LC-273	10/18/1994	3	4	2.7		2.7	5.7	6.7
LC-274	10/15/1994	0	1	0.9		0.9	0.9	1.9
LC-274	10/15/1994	2	3	0.9		0.9	2.9	3.9
LC-275	10/17/1994	0	1	2.3		2.3	2.3	3.3
LC-275	10/17/1994	2	3	2.3		2.3	4.3	5.3
LC-276	10/15/1994	0	1	1.0		1.0	1.0	2.0
LC-276	10/15/1994	2	3	1.0		1.0	3.0	4.0
LC-277	10/15/1994	0	1	0.6		0.6	0.6	1.6
LC-277	10/15/1994	2	3	0.6		0.6	2.6	3.6
LC-278	10/15/1994	0	1	0		0	0	1
LC-278	10/15/1994	2	3	0		0	2	3
LC-279	10/15/1994	0	1	0.9		0.9	0.9	1.9
LC-279	10/15/1994	2	3	0.9		0.9	2.9	3.9
LC-280	10/15/1994	0	1	2.0		2.0	2.0	3.0
LC-280	10/15/1994	2	3	2.0		2.0	4.0	5.0
LC-281	10/15/1994	1	2	1.7	1.33	3.0	4.0	5.0
LC-281	10/15/1994	3	4	1.7	1.33	3.0	6.0	7.0
LC-282	10/15/1994	0	1	1.1		1.1	1.1	2.1
LC-282	10/15/1994	2	3	1.1		1.1	3.1	4.1
LC-283	10/15/1994	0	1	1.5		1.5	1.5	2.5
LC-283	10/15/1994	2	3	1.5		1.5	3.5	4.5
LC-284	10/15/1994	0	1	2.4		2.4	2.4	3.4
LC-284	10/15/1994	2	3	2.4		2.4	4.4	5.4
LC-285	10/20/1994	0.5	1	2.3	1.33	3.6	4.1	4.6
LC-285	10/20/1994	1	2	2.3	1.33	3.6	4.6	5.6
LC-285	10/20/1994	2.5	3	2.3	1.33	3.6	6.1	6.6
LC-285	10/20/1994	3	4	2.3	1.33	3.6	6.6	7.6
LC-286	10/20/1994	0.5	1	2.2	0.66	2.9	3.4	3.9

Table A-1. Soil Depth Changes for Samples Collected Prior to the CBA Soil Cover

Location	Sample Date	Original D1 (ft)	Original D2 (ft)	Soil Cap Thickness (ft)	Concrete Thickness (ft)	Total Depth Change (ft)	New D1 (ft)	New D2 (ft)
LC-286	10/20/1994	1	2	2.2	0.66	2.9	3.9	4.9
LC-286	10/20/1994	3	4	2.2	0.66	2.9	5.9	6.9
LC-287	10/19/1994	1	2	1.9	1.33	3.2	4.2	5.2
LC-287	10/19/1994	2.5	3	1.9	1.33	3.2	5.7	6.2
LC-287	10/19/1994	3	4	1.9	1.33	3.2	6.2	7.2
LC-288	10/20/1994	1	2	2.2	1.33	3.6	4.6	5.6
LC-288	10/20/1994	2.5	3	2.2	1.33	3.6	6.1	6.6
LC-288	10/20/1994	3	4	2.2	1.33	3.6	6.6	7.6
LC-289	10/19/1994	0.5	1	1.9	1.33	3.2	3.7	4.2
LC-289	10/19/1994	1.5	2.5	1.9	1.33	3.2	4.7	5.7
LC-289	10/19/1994	3.5	4.5	1.9	1.33	3.2	6.7	7.7
LC-290	10/18/1994	0	1	2.2		2.2	2.2	3.2
LC-290	10/18/1994	2	3	2.2		2.2	4.2	5.2
LC-291	10/19/1994	0	1	2.6		2.6	2.6	3.6
LC-291	10/19/1994	2	3	2.6		2.6	4.6	5.6
LC-291	10/19/1994	4	5	2.6		2.6	6.6	7.6
LC-291	10/18/1994	0	1	2.6		2.6	2.6	3.6
LC-291	10/18/1994	2	3	2.6		2.6	4.6	5.6
LC-291	10/18/1994	4	5	2.6		2.6	6.6	7.6
LC-292	10/18/1994	0	1	2.0		2.0	2.0	3.0
LC-292	10/18/1994	2	3	2.0		2.0	4.0	5.0
LC-293	10/17/1994	0	1	1.4		1.4	1.4	2.4
LC-293	10/17/1994	2	3	1.4		1.4	3.4	4.4
LC-294	10/17/1994	0	1	0		0	0	1
LC-294	10/17/1994	2	3	0		0	2	3
LC-295	10/17/1994	0	1	1.1		1.1	1.1	2.1
LC-295	10/17/1994	2	3	1.1		1.1	3.1	4.1
LC-296	10/18/1994	0	1	1.6		1.6	1.6	2.6
LC-296	10/18/1994	2	3	1.6		1.6	3.6	4.6
LC-297	10/17/1994	0	1	2.2		2.2	2.2	3.2
LC-297	10/17/1994	2	3	2.2		2.2	4.2	5.2
LC-298	10/17/1994	0	1	1.2		1.2	1.2	2.2
LC-298	10/17/1994	2	3	1.2		1.2	3.2	4.2
LC-299	10/17/1994	0	1	2.7		2.7	2.7	3.7
LC-299	10/17/1994	2	3	2.7		2.7	4.7	5.7
LC-300	10/17/1994	0	1	1.7		1.7	1.7	2.7
LC-300	10/17/1994	2	3	1.7		1.7	3.7	4.7
LC-301	10/17/1994	0	1	2.3		2.3	2.3	3.3
LC-301	10/17/1994	2	3	2.3		2.3	4.3	5.3
LC-302	10/17/1994	0	1	1.3		1.3	1.3	2.3
LC-302	10/17/1994	2	3	1.3		1.3	3.3	4.3
LC-304	10/17/1994	0	1	0.8		0.8	0.8	1.8
LC-304	10/17/1994	2	3	0.8		0.8	2.8	3.8
LC-305	10/17/1994	0	1	1.0		1.0	1.0	2.0
LC-305	10/17/1994	2	3	1.0		1.0	3.0	4.0
LC-306	10/18/1994	0	1	1.4		1.4	1.4	2.4
LC-306	10/18/1994	2	3	1.4		1.4	3.4	4.4
LC-307	10/17/1994	0	1	1.7		1.7	1.7	2.7
LC-307	10/17/1994	2	3	1.7		1.7	3.7	4.7
SB-477	1/15/1997	22	22	2.6	0.66	3.3	25.3	25.3

Table A-1. Soil Depth Changes for Samples Collected Prior to the CBA Soil Cover

Location	Sample Date	Original D1 (ft)	Original D2 (ft)	Soil Cap Thickness (ft)	Concrete Thickness (ft)	Total Depth Change (ft)	New D1 (ft)	New D2 (ft)
SB-478	1/16/1997	16	16	2.5		2.5	18.5	18.5
SB-478	1/16/1997	17	17	2.5		2.5	19.5	19.5
SB-478	1/16/1997	23	23	2.5		2.5	25.5	25.5
SB-478	1/16/1997	37	37	2.5		2.5	39.5	39.5
SB-478	1/16/1997	42	42	2.5		2.5	44.5	44.5
SB-479	1/21/1997	10	10	2.6	0.66	3.3	13.3	13.3
SB-479	1/21/1997	17	17	2.6	0.66	3.3	20.3	20.3
SB-479	1/21/1997	30	30	2.6	0.66	3.3	33.3	33.3
SB-479	1/21/1997	35	35	2.6	0.66	3.3	38.3	38.3
SB-479	1/21/1997	37	37	2.6	0.66	3.3	40.3	40.3
SB-479	1/21/1997	42	42	2.6	0.66	3.3	45.3	45.3
SB-480	1/15/1997	5	5	2.6	0.66	3.2	8.2	8.2
SB-480	1/15/1997	11	11	2.6	0.66	3.2	14.2	14.2
SB-480	1/15/1997	17	17	2.6	0.66	3.2	20.2	20.2
SB-480	1/15/1997	30	30	2.6	0.66	3.2	33.2	33.2
SB-480	1/15/1997	35	35	2.6	0.66	3.2	38.2	38.2
SB-480	1/14/1997	5	5	2.6	0.66	3.2	8.2	8.2
SB-480	1/14/1997	11	11	2.6	0.66	3.2	14.2	14.2
SB-480	1/14/1997	17	17	2.6	0.66	3.2	20.2	20.2
SB-480	1/14/1997	30	30	2.6	0.66	3.2	33.2	33.2
SB-480	1/14/1997	35	35	2.6	0.66	3.2	38.2	38.2
SB-481	1/16/1997	7	7	2.6		2.6	9.6	9.6
SB-481	1/16/1997	14	14	2.6		2.6	16.6	16.6
SB-481	1/16/1997	20	20	2.6		2.6	22.6	22.6
SB-481	1/16/1997	24	24	2.6		2.6	26.6	26.6
SB-481	1/16/1997	37	37	2.6		2.6	39.6	39.6
SB-481	1/16/1997	42	42	2.6		2.6	44.6	44.6
SB-482	1/22/1997	8	8	2.4	0.66	3.1	11.1	11.1
SB-482	1/22/1997	16	16	2.4	0.66	3.1	19.1	19.1
SB-482	1/22/1997	19	19	2.4	0.66	3.1	22.1	22.1
SB-482	1/22/1997	24	24	2.4	0.66	3.1	27.1	27.1
SB-482	1/22/1997	28	28	2.4	0.66	3.1	31.1	31.1
SB-482	1/22/1997	32	32	2.4	0.66	3.1	35.1	35.1
SB-482	1/22/1997	37	37	2.4	0.66	3.1	40.1	40.1
SB-482	1/22/1997	44	44	2.4	0.66	3.1	47.1	47.1
SB-483	1/22/1997	12	12	2.8	1.33	4.1	16.1	16.1
SB-483	1/22/1997	23	23	2.8	1.33	4.1	27.1	27.1
SB-483	1/22/1997	33	33	2.8	1.33	4.1	37.1	37.1
SB-483	1/22/1997	43	43	2.8	1.33	4.1	47.1	47.1
SB-484	1/27/1997	5	5	2.7	1.33	4.1	9.1	9.1
SB-484	1/27/1997	15	15	2.7	1.33	4.1	19.1	19.1
SB-484	1/27/1997	27	27	2.7	1.33	4.1	31.1	31.1
SB-484	1/27/1997	29	29	2.7	1.33	4.1	33.1	33.1
SB-484	1/27/1997	31	31	2.7	1.33	4.1	35.1	35.1
SB-484	1/27/1997	37	37	2.7	1.33	4.1	41.1	41.1
SB-484	1/27/1997	39	39	2.7	1.33	4.1	43.1	43.1
SB-484	1/27/1997	42	42	2.7	1.33	4.1	46.1	46.1
SB-484	1/27/1997	53	53	2.7	1.33	4.1	57.1	57.1

Table A-2. Historical Soil Samples to be Included in OU2 HHBRA

Location	Sample ID	D1 (ft)	D2 (ft)
96249-16	96249-16	3.8	4.8
96261-08	96261-08	1.6	2.6
96262-15	96262-15	2.0	3.0
96262-16	96262-16	3.0	4.0
96262-17	96262-17	2.1	3.1
96262-18	96262-18	3.1	4.1
96262-19	96262-19	3.1	3.2
96263-SRY-01	96263-SRY-01	1.2	2.7
96263-SRY-02	96263-SRY-02	1.4	4.4
96263-SRY-03	96263-SRY-03	1.4	3.9
96312-SRY-31	96312-SRY-31	1.5	4.7
97142-M94	97142-M94	0.9	5.4
CB2-SB-1	18334-CB2-SB-1-1	4	4
IG-1	09259-SS-IG-1	0.4	2.9
IG-2	09259-SS-IG-2	0.8	3.3
IG-3	09259-SS-IG-3	1.1	3.6
IG-4	09259-SS-IG-4	1.4	3.9
IG-5	09259-SS-IG-5	1.4	3.9
IG-6	09259-SS-IG-6	1.6	4.1
IG-7	09259-SS-IG-7	1.5	4.0
IG-8	09259-SS-IG-8	1.3	3.8
LC-217	LC-217-SLA	1.6	2.6
LC-246	LC-246-SLA	1.7	2.7
LC-246	LC-246-SLB	3.7	4.7
LC-247	LC-247-SLA	1.6	2.6
LC-247	LC-247-SLB	3.6	4.6
LC-248	LC-248-SLA	1.8	2.8
LC-249	LC-249-SLA	1.3	2.3
LC-249	LC-249-SLB	3.3	4.3
LC-250	LC-250-SLA	1.2	2.2
LC-250	LC-250-SLB	3.2	4.2
LC-251	LC-251-SLA	1.3	2.3
LC-251	LC-251-SLB	3.3	4.3
LC-252	LC-252-SLA	1.4	2.4
LC-252	LC-252-SLB	3.4	4.4
LC-253	LC-253-SLA	1.2	2.2
LC-253	LC-253-SLB	3.2	4.2
LC-262	LC-262-SLA	4.5	5.5
LC-263	LC-263-SLA	4.4	5.4
LC-264	LC-264-SLA	2.6	3.6
LC-264	LC-264-SLB	4.6	5.6
LC-265	LC-265-SLA	2.4	3.4
LC-265	LC-265-SLB	4.4	5.4
LC-266	LC-266-SLA	1.8	2.8
LC-266	LC-266-SLB	3.8	4.8
LC-267	LC-267-SLA	2.3	3.3

Table A-2. Historical Soil Samples to be Included in OU2 HHBRA

Location	Sample ID	D1 (ft)	D2 (ft)
LC-267	LC-267-SLB	4.3	5.3
LC-268	LC-268-SLA	2.4	3.4
LC-268	LC-268-SLB	4.4	5.4
LC-269	LC-269-SLA	1.0	2.0
LC-269	LC-269-SLB	3.0	4.0
LC-270	LC-270-SLA	2.1	3.1
LC-270	LC-270-SLB	4.1	5.1
LC-271	LC-271-SLA	1.4	2.4
LC-271	LC-271-SLB	3.4	4.4
LC-272	LC-272-SLA	3.6	4.6
LC-273	LC-273-SLA	3.7	4.7
LC-274	LC-274-SLA	0.9	1.9
LC-274	LC-274-SLB	2.9	3.9
LC-275	LC-275-SLA	2.3	3.3
LC-275	LC-275-SLB	4.3	5.3
LC-276	LC-276-SLA	1.0	2.0
LC-276	LC-276-SLB	3.0	4.0
LC-277	LC-277-SLA	0.6	1.6
LC-277	LC-277-SLB	2.6	3.6
LC-278	LC-278-SLA	0	1
LC-278	LC-278-SLB	2	3
LC-279	LC-279-SLA	0.9	1.9
LC-279	LC-279-SLB	2.9	3.9
LC-280	LC-280-SLA	2.0	3.0
LC-280	LC-280-SLB	4.0	5.0
LC-281	LC-281-SLA	4.0	5.0
LC-282	LC-282-SLA	1.1	2.1
LC-282	LC-282-SLB	3.1	4.1
LC-283	LC-283-SLA	1.5	2.5
LC-283	LC-283-SLB	3.5	4.5
LC-284	LC-284-SLA	2.4	3.4
LC-284	LC-284-SLB	4.4	5.4
LC-285	LC-285-SLA	4.6	5.6
LC-285	LC-285-SLC	4.1	4.6
LC-286	LC-286-SLA	3.9	4.9
LC-286	LC-286-SLC	3.4	3.9
LC-287	LC-287-SLA	4.2	5.2
LC-288	LC-288-SLA	4.6	5.6
LC-289	LC-289-SLA	4.7	5.7
LC-289	LC-289-SLC	3.7	4.2
LC-290	LC-290-SLA	2.2	3.2
LC-290	LC-290-SLB	4.2	5.2
LC-291	LC-291-SLA	2.6	3.6
LC-291	LC-291-SLB	4.6	5.6
LC-292	LC-292-SLA	2.0	3.0
LC-292	LC-292-SLB	4.0	5.0

Table A-2. Historical Soil Samples to be Included in OU2 HHBRA

Location	Sample ID	D1 (ft)	D2 (ft)
LC-293	LC-293-SLA	1.4	2.4
LC-293	LC-293-SLB	3.4	4.4
LC-294	LC-294-SLA	0	1
LC-294	LC-294-SLB	2	3
LC-295	LC-295-SLA	1.1	2.1
LC-295	LC-295-SLB	3.1	4.1
LC-296	LC-296-SLA	1.6	2.6
LC-296	LC-296-SLB	3.6	4.6
LC-297	LC-297-SLA	2.2	3.2
LC-297	LC-297-SLB	4.2	5.2
LC-298	LC-298-SLA	1.2	2.2
LC-298	LC-298-SLB	3.2	4.2
LC-299	LC-299-SLA	2.7	3.7
LC-299	LC-299-SLB	4.7	5.7
LC-300	LC-300-SLA	1.7	2.7
LC-300	LC-300-SLB	3.7	4.7
LC-301	LC-301-SLA	2.3	3.3
LC-301	LC-301-SLB	4.3	5.3
LC-302	LC-302-SLA	1.3	2.3
LC-302	LC-302-SLB	3.3	4.3
LC-304	LC-304-SLA	0.8	1.8
LC-304	LC-304-SLB	2.8	3.8
LC-305	LC-305-SLA	1.0	2.0
LC-305	LC-305-SLB	3.0	4.0
LC-306	LC-306-SLA	1.4	2.4
LC-306	LC-306-SLB	3.4	4.4
LC-307	LC-307-SLA	1.7	2.7
LC-307	LC-307-SLB	3.7	4.7

Attachment B
Surrogate Chemical List

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

Ref: 4WD-SRB DEC 0 1 2009

Via Certified Mail

Mr. Prashant K. Gupta
Honeywell, Inc.
4101 Bermuda Hundred Road
Chester, VA 23836

Re: Operable Unit 3 (Uplands) Human Health Risk Assessment (HHRA): LCP Chemical National Priorities List Site, Brunswick, Glynn County, GA

Dear Mr. Gupta:

Through a February 24, 2009, letter, EPA commented on deficiencies found in the August 2008 draft of the referenced document. The HHRA was revised and resubmitted to EPA and received in these offices on March 29, 2009. Though a June 22, 2009 letter EPA provided comments on the March 2009 draft. During July through August 2009, a number of meetings were held to discuss the data set to be used in the HHRA. On September 8, 2009, a final meeting was held in these offices to discuss the data set, with an understanding that EPA and the Georgia Department of Environmental Protection (GaEPD) would jointly provide the provisional peer reviewed toxicity values (PPRTVs) for certain compounds. In addition, EPA was to provide surrogates for a number of analytes.

Enclosed is a table containing the final surrogates recommended by both GaEPD and EPA. I understand this is the final information required to revise the March 2009 draft of the OU3 HHRA.

Pursuant to Section VIII of the Administrative Order on Consent for RI/FS for the Site, EPA Docket No. 95-17-C (AOC for RI/FS), please submit the revised HHRA within thirty (30) calendar days of receipt of this letter.

Once both human health and ecological risk assessments are finalized and approved by EPA, I will request the submittal of the OU3 RI Report and the deliverable described under Task 6 (Development and Screening of Remedial Action Alternatives) of the Scope of Work for the RI/FS. EPA and GaEPD will review this submittal and, if necessary, comment on it before requesting the submittal of the Detailed Analysis of Remedial Action Alternatives (Task 7 of the Scope of Work for the RI/FS).

Should you have any questions regarding the preceding, please contact me at (404) 562-8937.

Sincerely,

Galo Jackson
Remedial Project Manager
South Superfund Remedial Branch

Enclosure

cc: J. McNamara, GaEPD

Parameter	Surrogate
1,1-Dichloropropene	1,3-Dichloropropene
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene
2,2-Dichloropropane	1,3-dichloropropane
2-Hexanone	on IRIS (591-78-6)
2-Nitrophenol	2,4-Dinitrophenol
4-Chloro-3-methylphenol	2-Chlorophenol
4-Chlorophenyl-phenylether	Methoxychlor
4-Nitrophenol	2,4-Dinitrophenol
Acenaphthylene	Pyrene
Benzo(g,h,i)perylene	Pyrene
Bromochloromethane	Bromodichloromethane
delta-BHC (HCH)	alpha-BHC (HCH)
Endosulfan I	Endosulfan
Endosulfan II	Endosulfan
Endosulfan sulfate	Endosulfan
Endrin aldehyde	Endrin
Endrin ketone	Endrin
Phenanthrene	Pyrene
p-Isopropyltoluene	Toluene
2-Nitroaniline	listed in RSLT with PPRTV (CASN 88-74-4)
1,3-Dichlorobenzene	1,2-DCB
2,2'-Chloroisopropylether	No recommended surrogate
2,2'-Oxybis(1-Chloropropane)	No recommended surrogate
2-Chloroethyl vinyl ether	No recommended surrogate
3/4-Methylphenol	3-Methylphenol on IRIS
4-Bromophenyl-phenylether	No recommended surrogate
Dimethylphthalate	Screening subchronic reference dose = 0.1 mg/kg-d
Di-n-octylphthalate	No recommended surrogate
Hexadecenoic Acid	No recommended surrogate
Methylethylidene Bicyclooctane [edited spelling]	No recommended surrogate
n-Butylbenzene	Ethylbenzene
n-Propylbenzene	Ethylbenzene
Octahydrotrimethylmethylethylphenanthrenol	No recommended surrogate
sec-Butylbenzene	Cumene (isopropylbenzene)
Tellurium	No surrogate
tert-Butylbenzene	Cumene (isopropylbenzene)
Yttrium	No recommended surrogate
alpha-Chlordane	Chlordane
cis-1,3-Dichloropropene	1,3-Dichloropropene on IRIS (542-75-6)
Dibenzofuran	Screening chronic reference dose = 0.001 mg/kg-d
gamma-Chlordane	Chlordane
Titanium	No recommended surrogate
trans-1,3-Dichloropropene	1,3-Dichloropropene on IRIS (542-75-6)

Attachment C
Exposure Factors and Equations

Table C-1A. Receptor Exposure Factors and Intake Equations - Soil Industrial Worker (RME)

Parameter	Symbol	(units)	Current/Future Industrial Worker	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	n/a
Volatilization Factor	VF	(m^3/kg)	chem-specific	n/a
GI Tract Absorption	GIABS	(unitless)	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.36E+09	OU3
Body Weight	BW	(kg)	80	RSL
Exposure Frequency	EF	(days/year)	225	OU3
Exposure Duration	ED	(years)	25	RSL
Exposure Time	ET	(hr/dy)	8	RSL
Surface Area	SA	(cm^2)	3,527	RSL
Adherence Factor	AF	(mg/cm^2)	0.12	RSL
Conversion Factor	CF	(kg/mg)	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	100	RSL
Avg Time (non-cancer)	AT nc	(d)	9125	RSL
Avg Time (cancer)	AT c	(d)	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer - NonResident

$$LADD = \frac{CS \times EF \times ED \times IR \times CF \times RBA}{BW \times ATc}$$

Noncancer ADD = CS x RBA x 7.71E-07

Cancer LADD = CS x RBA x 2.75E-07

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

Noncancer ADD = CS x (1/VF + 1/PEF) x 2.05E-01

Cancer LADD = CS x (1/VF + 1/PEF) x 7.34E+01

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer

$$LADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATc \times GIABS}$$

Noncancer ADD = (CS x ABS / GIABS) x 3.26E-06

Cancer LADD = CS x ABS / GIABS x 1.16E-06

Table C-1B. Receptor Exposure Factors and Intake Equations - Soil Industrial Worker (CTE)

Parameter	Symbol	(units)	Current/Future Industrial Worker	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	n/a
Volatilization Factor	VF	(m^3/kg)	chem-specific	n/a
GI Tract Absorption	GIABS	(unitless)	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.36E+09	OU3
Body Weight	BW	(kg)	80	RSL
Exposure Frequency	EF	(days/year)	219	OU3
Exposure Duration	ED	(years)	9	OU3
Exposure Time	ET	(hr/dy)	8	RSL
Surface Area	SA	(cm^2)	3,527	RSL
Adherence Factor	AF	(mg/cm^2)	0.02	OU3
Conversion Factor	CF	(kg/mg)	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	25	OU3
Avg Time (non-cancer)	AT nc	(d)	3285	RSL
Avg Time (cancer)	AT c	(d)	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer - NonResident

$$LADD = \frac{CS \times EF \times ED \times IR \times CF \times RBA}{BW \times ATc}$$

Noncancer ADD = CS x RBA x 1.88E-07

Cancer LADD = CS x RBA x 2.41E-08

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

Noncancer ADD = CS x (1/VF + 1/PEF) x 2.00E-01

Cancer LADD = CS x (1/VF + 1/PEF) x 2.57E+01

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer

$$LADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATc \times GIABS}$$

Noncancer ADD = (CS x ABS / GIABS) x 5.29E-07

Cancer LADD = CS x ABS / GIABS x 6.80E-08

Table C-2A. Receptor Exposure Factors and Intake Equations - Soil Excavation Worker (RME)

Parameter	Symbol	(units)	Future Excavation Worker	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	n/a
Volatilization Factor*	VF	(m^3/kg)	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.06E+06	NCDEQ
GI Tract Absorption	GIABS	(unitless)	chem-specific	n/a
Body Weight	BW	(kg)	80	RSL
Exposure Frequency	EF	(days/year)	260	OU3
Weeks Work	EW	(wk/yr)	26	OU3
Exposure Duration	ED	(years)	1	RSL
Exposure Time	ET	(hr/dy)	8	RSL
Conversion Factor	CF	(kg/mg)	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	330	RSL
Surface Area	SA	(cm^2)	3,527	RSL
Adherence Factor	AF	(mg/cm^2)	0.3	RSL
Avg Time (non-cancer)=EWx7d/wxED	AT nc	(d)	182	RSL
Avg Time (cancer)	AT c	(d)	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

NCDEQ: North Carolina Department of Environmental Quality Risk Evaluation Equations and Calculations (https://files.nc.gov/ncdeq/Waste%20Management/DWM/SF/RiskBasedRemediation/20171024_RiskEvalEqnsandCalcs.pdf)

*For construction worker, use sub-chronic toxicity values where available and VFcw

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer

$$LADD = \frac{CS \times EF \times ED \times IR \times CF \times RBA}{BW \times ATc}$$

	Excav Worker
Noncancer ADD = CS x RBA x	5.89E-06
Cancer LADD = CS x RBA x	4.20E-08

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

	Excav Worker
Noncancer ADD = CS x (1/VF + 1/PEF) x	4.76E-01
Cancer LADD = CS x (1/VF + 1/PEF) x	3.39E+00

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer

$$LADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATc \times GIABS}$$

	Excav Worker
Noncancer ADD = (CS x ABS / GIABS) x	1.89E-05
Cancer LADD = CS x ABS / GIABS x	1.35E-07

Table C-2B. Receptor Exposure Factors and Intake Equations - Soil Excavation Worker (CTE)

Parameter	Symbol	(units)	Future Excavation Worker	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	n/a
Volatilization Factor*	VF	(m^3/kg)	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.06E+06	NCDEQ
GI Tract Absorption	GIABS	(unitless)	chem-specific	n/a
Body Weight	BW	(kg)	80	RSL
Exposure Frequency	EF	(days/year)	260	OU3
Weeks Work	EW	(wk/yr)	12	OU3
Exposure Duration	ED	(years)	1	OU3
Exposure Time	ET	(hr/dy)	8	RSL
Conversion Factor	CF	(kg/mg)	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	100	OU3
Surface Area	SA	(cm^2)	1,900	OU3
Adherence Factor	AF	(mg/cm^2)	0.1	OU3
Avg Time (non-cancer)=EWx7d/wxED	AT nc	(d)	84	RSL
Avg Time (cancer)	AT c	(d)	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

NCDEQ: North Carolina Department of Environmental Quality Risk Evaluation Equations and Calculations
(https://files.nc.gov/ncdeq/Waste%20Management/DWM/SF/RiskBasedRemediation/20171024_RiskEvalEqnsandCalcs.pdf)

*For construction worker, use sub-chronic toxicity values where available and VFcw

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer

$$LADD = \frac{CS \times EF \times ED \times IR \times CF \times RBA}{BW \times ATc}$$

	Excav Worker
Noncancer ADD = CS x RBA x	3.87E-06
Cancer LADD = CS x RBA x	1.27E-08

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

	Excav Worker
Noncancer ADD = CS x (1/VF + 1/PEF) x	1.03E+00
Cancer LADD = CS x (1/VF + 1/PEF) x	3.39E+00

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer

$$LADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATc \times GIABS}$$

	Excav Worker
Noncancer ADD = (CS x ABS / GIABS) x	7.35E-06
Cancer LADD = CS x ABS / GIABS x	2.42E-08

Table C-3A. Receptor Exposure Factors and Intake Equations - Soil Adolescent Trespasser (RME)

Parameter	Symbol	(units)	Current Adolescent Trespasser	Future Adolescent Trespasser	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	chem-specific	n/a
Volatilization Factor	VF	(m^3/kg)	chem-specific	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.36E+09	1.36E+09	OU3
GI Tract Absorption	GIABS	(unitless)	chem-specific	chem-specific	n/a
Body Weight	BW	(kg)	45	45	OU3, R4
Exposure Frequency	EF	(days/year)	24	52	OU3
Exposure Duration	ED	(years)	10	10	OU3, R4
Exposure Time	ET	(hr/dy)	4	4	prof judg
Conversion Factor	CF	(kg/mg)	1E-06	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	50	50	OU3
Surface Area	SA	(cm^2)	3,940	3,940	OU3
Adherence Factor	AF	(mg/cm^2)	0.2	0.2	OU3
Avg Time (non-cancer)	AT nc	(d)	3650	3650	RSL
Avg Time (cancer)	AT c	(d)	25550	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

R4: EPA Region 4 Guidance

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer

$$LADD = \frac{CS \times EF \times ED \times IR \times CF \times RBA}{BW \times ATc}$$

	Current	Future
Noncancer ADD = CS x RBA x	7.31E-08	1.58E-07
Cancer LADD = CS x RBA x	1.04E-08	2.26E-08

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

	Current	Future
Noncancer ADD = CS x (1/VF + 1/PEF) x	1.10E-02	2.37E-02
Cancer LADD = CS x (1/VF + 1/PEF) x	1.57E+00	3.39E+00

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer

$$LADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATc \times GIABS}$$

	Current	Future
Noncancer ADD = (CS x ABS / GIABS) x	1.15E-06	2.49E-06
Cancer LADD = CS x ABS / GIABS x	1.64E-07	3.56E-07

Table C-3B. Receptor Exposure Factors and Intake Equations - Soil Adolescent Trespasser (CTE)

Parameter	Symbol	(units)	Current Adolescent Trespasser	Future Adolescent Trespasser	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	chem-specific	n/a
Volatilization Factor	VF	(m^3/kg)	chem-specific	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.36E+09	1.36E+09	OU3
GI Tract Absorption	GIABS	(unitless)	chem-specific	chem-specific	n/a
Body Weight	BW	(kg)	45	45	OU3, R4
Exposure Frequency	EF	(days/year)	6	6	OU3
Exposure Duration	ED	(years)	10	10	OU3, R4
Exposure Time	ET	(hr/dy)	4	4	prof judg
Conversion Factor	CF	(kg/mg)	1E-06	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	10	10	OU3
Surface Area	SA	(cm^2)	2,750	2,750	OU3
Adherence Factor	AF	(mg/cm^2)	0.1	0.1	OU3
Avg Time (non-cancer)	AT nc	(d)	3650	3650	RSL
Avg Time (cancer)	AT c	(d)	25550	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

R4: EPA Region 4 Guidance

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer

$$LADD = \frac{CS \times EF \times ED \times IR \times CF \times RBA}{BW \times ATc}$$

	Current	Future
Noncancer ADD = CS x RBA x	3.65E-09	3.65E-09
Cancer LADD = CS x RBA x	5.22E-10	5.22E-10

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

	Current	Future
Noncancer ADD = CS x (1/VF + 1/PEF) x	2.74E-03	2.74E-03
Cancer LADD = CS x (1/VF + 1/PEF) x	3.91E-01	3.91E-01

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer

$$LADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATc \times GIABS}$$

	Current	Future
Noncancer ADD = (CS x ABS / GIABS) x	1.00E-07	1.00E-07
Cancer LADD = CS x ABS / GIABS x	1.44E-08	1.44E-08

Table C-4A. Receptor Exposure Factors and Intake Equations - Soil Hypothetical Residents (RME)

Parameter	Symbol	(units)	Hypothetical Child Resident	Hypothetical Adult Resident	Hypothetical Resident-Adjusted	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	eqn below	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	eqn below	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	chem-specific	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	chem-specific	chem-specific	n/a
Volatilization Factor	VF	(m^3/kg)	chem-specific	chem-specific	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.36E+09	1.36E+09	1.36E+09	OU3
GI Tract Absorption	GIABS	(unitless)	chem-specific	chem-specific	chem-specific	n/a
Body Weight	BW	(kg)	15	80	n/a	RSL
Exposure Frequency	EF	(days/year)	350	350	350	RSL
Exposure Duration	ED	(years)	6	26	26	RSL
Exposure Time	ET	(hr/dy)	24	24	24	RSL
Conversion Factor	CF	(kg/mg)	1E-06	1E-06	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	0.042	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	1000	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	200	100	n/a	RSL
Age Adjusted Ingestion Rate	IFs	(mg/kg)	n/a	n/a	36,750	RSL
Age Adjusted Ingestion Rate - Mutagenic	IFsm	(mg/kg)	n/a	n/a	166833	RSL
Surface Area	SA	(cm^2)	2,373	6,032	n/a	RSL
Age Adjusted Dermal Contact Factor	DFS	(mg/kg)	n/a	n/a	103,390	RSL
Age Adjusted Dermal Contact Factor - Mutagenic	DFSm	(mg/kg)	n/a	n/a	428,260	RSL
Inhalation Mutagenic Exposure	EXm	(days)	n/a	n/a	25,200	RSL
Adherence Factor	AF	(mg/cm^2)	0.2	0.07	n/a	RSL
Avg Time (non-cancer)	AT nc	(d)	2190	9490	9490	RSL
Avg Time (cancer)	AT c	(d)	25550	25550	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer Adj

$$LADD = \frac{CS \times IFs \times CF \times RBA}{ATc}$$

Ingestion - Mutagenic

$$\frac{CS \times IFsm \times CF \times RBA}{ATc}$$

	Child	Adult	Res-Adj
Noncancer ADD = CS x RBA x	1.28E-05	1.20E-06	NA
Cancer LADD = CS x RBA x	NA	NA	1.44E-06
Mutagenic Cancer LADD = CS x RBA x	NA	NA	6.53E-06

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Inhalation Cancer - Mutagenic

$$\frac{CS \times CF\_InhC \times EXm \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

Exm =∑ (ET x EF x ED x CF_Inh x Factor

	Child	Adult	Res-Adj
Noncancer ADD = CS x (1/VF + 1/PEF) x	9.59E-01	9.59E-01	NA
Cancer LADD = CS x (1/VF + 1/PEF) x	NA	NA	3.56E+02
Mutagenic Cancer LADD = CS x (1/VF + 1/PEF) x	NA	NA	9.86E+02

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer - Resident -Adjusted

$$LADD = \frac{CS \times CF \times DFS \times ABS}{ATc \times GIABS}$$

Dermal Cancer - Res. Mutagenic

$$\frac{CS \times CF \times DFSm \times ABS}{ATc \times GIABS}$$

	Child	Adult	Res-Adj
Noncancer ADD = (CS x ABS / GIABS) x	3.03E-05	5.06E-06	NA
Cancer LADD = CS x ABS / GIABS x	NA	NA	4.05E-06
Mutagenic Cancer LADD = CS x SFo / GIABS x	NA	NA	1.68E-05

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Table C-4B. Receptor Exposure Factors and Intake Equations - Soil Hypothetical Residents (CTE)

Parameter	Symbol	(units)	Hypothetical Child Resident	Hypothetical Adult Resident	Hypothetical Resident-Adjusted	Source
Average Daily Dose (noncancer)	ADD	(mg/kg-d)	eqn below	eqn below	eqn below	n/a
Lifetime Average Daily Dose (cancer)	LADD	(mg/kg-d)	eqn below	eqn below	eqn below	n/a
Concentration in Soil	CS (i.e., EPC)	(mg/kg)	chem-specific	chem-specific	chem-specific	n/a
Relative Bioavailability	RBA	(unitless)	chem-specific	chem-specific	chem-specific	n/a
Volatilization Factor	VF	(m^3/kg)	chem-specific	chem-specific	chem-specific	n/a
Particulate Emission Factor	PEF	(m^3/kg)	1.36E+09	1.36E+09	1.36E+09	OU3
GI Tract Absorption	GIABS	(unitless)	chem-specific	chem-specific	chem-specific	n/a
Body Weight	BW	(kg)	15	80	n/a	RSL
Exposure Frequency	EF	(days/year)	350	350	350	RSL
Exposure Duration	ED	(years)	2	9	9	OU3
Exposure Time	ET	(hr/dy)	24	24	24	RSL
Conversion Factor	CF	(kg/mg)	1E-06	1E-06	1E-06	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.042	0.042	0.042	n/a
Conversion Factor Inh Carc	CF_InhC	(ug/mg)	1000	1000	1000	n/a
Soil Ingestion Rate	IR_S	(mg/dy)	100	50	n/a	OU3
Age Adjusted Ingestion Rate	IFs	(mg/kg)	n/a	n/a	36,750	RSL
Age Adjusted Ingestion Rate - Mutagenic	IFsm	(mg/kg)	n/a	n/a	166833	RSL
Surface Area	SA	(cm^2)	1,800	4,800	n/a	OU3
Age Adjusted Dermal Contact Factor	DFS	(mg/kg)	n/a	n/a	103,390	RSL
Age Adjusted Dermal Contact Factor - Mutagenic	DFSm	(mg/kg)	n/a	n/a	428,260	RSL
Inhalation Mutagenic Exposure	EXm	(days)	n/a	n/a	25,200	RSL
Adherence Factor	AF	(mg/cm^2)	0.2	0.07	n/a	RSL
Avg Time (non-cancer)	AT nc	(d)	730	3285	3285	RSL
Avg Time (cancer)	AT c	(d)	25550	25550	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CS \times IRs \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer Adj

$$LADD = \frac{CS \times IFs \times CF \times RBA}{ATc}$$

Ingestion - Mutagenic

$$\frac{CS \times IFsm \times CF \times RBA}{ATc}$$

	Child	Adult	Res-Adj
Noncancer ADD = CS x RBA x	6.39E-06	5.99E-07	NA
Cancer LADD = CS x RBA x	NA	NA	1.44E-06
Mutagenic Cancer LADD = CS x RBA x	NA	NA	6.53E-06

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Inhalation Noncancer

$$ADD = \frac{CS \times CF\_Inh \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATnc}$$

Inhalation Cancer

$$LADD = \frac{CS \times CF\_Inh \times CF\_InhC \times EF \times ED \times ET \times (1/VF + 1/PEF)}{ATc}$$

Note: VF not used if constituent is not volatile

Inhalation Cancer - Mutagenic

$$\frac{CS \times CF\_InhC \times EXm \times (1/VF + 1/PEF)}{ATc}$$

Exm =∑ (ET x EF x ED x CF_Inh x Factor

	Child	Adult	Res-Adj
Noncancer ADD = CS x (1/VF + 1/PEF) x	9.59E-01	9.59E-01	NA
Cancer LADD = CS x (1/VF + 1/PEF) x	NA	NA	1.23E+02
Mutagenic Cancer LADD = CS x (1/VF + 1/PEF) x	NA	NA	9.86E+02

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Dermal Noncancer

$$ADD = \frac{CS \times CF \times EF \times ED \times SA \times AF \times ABS}{BW \times ATnc \times GIABS}$$

Dermal Cancer - Resident -Adjusted

$$LADD = \frac{CS \times CF \times DFS \times ABS}{ATc \times GIABS}$$

Dermal Cancer - Res. Mutagenic

$$\frac{CS \times CF \times DFSm \times ABS}{ATc \times GIABS}$$

	Child	Adult	Res-Adj
Noncancer ADD = (CS x ABS / GIABS) x	2.30E-05	4.03E-06	NA
Cancer LADD = CS x ABS / GIABS x	NA	NA	4.05E-06
Mutagenic Cancer LADD = CS x SFo / GIABS x	NA	NA	1.68E-05

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Table C-5A. Receptor Exposure Factors and Intake Equations - Groundwater Hypothetical Residents (RME)

Parameter	Symbol	(units)	Hypothetical Child Resident	Hypothetical Adult Resident	Hypothetical Resident-Adjusted	Source
Concentration in GW	CW (i.e., EPC)	(µg/L)	chem-specific	chem-specific	chem-specific	n/a
DA event	DA_event	($\mu g/cm^2$-ev)	chem-specific	chem-specific	chem-specific	n/a
GI Tract Absorption	GIABS	(unitless)	chem-specific	chem-specific	chem-specific	n/a
Andleman Vol Factor	K	(L/m^3)	0.5	0.5	0.5	RSL
Body Weight	BW	(kg)	15	80	n/a	RSL
Event Frequency	EvF	(events/day)	1	1	1	RSL
Exposure Frequency	EF	(days/year)	350	350	350	OU3
Exposure Duration	ED	(years)	6	26	26	RSL
Exposure Time	ET	(hr/day)	24	24	24	RSL
Exposure Time GW	ETev	(hr/event)	0.54	0.71	n/a	RSL
Exposure Time Dermal/Water - Age-adjusted	tevent-adj	(hr/event)	n/a	n/a	0.68	RSL
Water Ingestion Rate - Age-adjusted	IFW	(L/kg)	n/a	n/a	394	RSL
Water Ingestion Rate - Mutagenic	IFWm	(L/kg)	n/a	n/a	1020	RSL
Water dermal contact factor - Age-adjusted	DFW	(cm2-ev/kg)	n/a	n/a	1989015	RSL eqn
Water dermal contact factor - Mutagenic	DFWm	(cm2-ev/kg)	n/a	n/a	6441633	RSL eqn
Inhalation Mutagenic Exposure	EXm	(days)	n/a	n/a	25200	RSL
Conversion Factor	CF	(mg/ug)	1.00E-03	1.00E-03	1.00E-03	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.0417	0.0417	0.0417	n/a
Water Ingestion Rate	IR_w	(L/dy)	0.78	2.5	n/a	RSL
Skin Surface Area	SA	(cm^2)	6,365	9,652	n/a	RSL
Avg Time (non-cancer)	AT nc	(d)	2190	9490	n/a	RSL
Avg Time (cancer)	AT c	(d)	25550	25550	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CW \times IR \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer -Adj

$$LADD = \frac{Cw \times IFW \times CF \times RBA}{Atc}$$

Ingestion Cancer - Mutagenic

$$\frac{Cw \times IFWm \times CF \times RBA}{Atc}$$

	Child	Adult	Resident-Adj
Noncancer ADD = CW x RBA x	4.99E-05	3.00E-05	NA
Cancer LADD = CW x RBA x	NA	NA	1.54E-05
Mutagenic Cancer LADD = CW x RBA x	NA	NA	3.99E-05

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Inhalation Noncancer

$$ADD = \frac{CW \times K \times ET \times CF\_Inh \times CF \times EF \times ED}{ATnc \times RfC}$$

Inhalation Cancer - Adj

$$LADD = \frac{CW \times K \times ET \times CF\_Inh \times EF \times (ED)}{ATc}$$

Inhalation Cancer - Mutagenic

$$\frac{CW \times K \times Exm}{ATc}$$

$EXm = \sum (ET \times EF \times ED \times CF\_Inh \times Factor)$

	Child	Adult	Resident-Adj
Noncancer ADD = CW x	4.79E-04	4.79E-04	NA
Cancer LADD = CW x	NA	NA	1.78E-01
Mutagenic Cancer LADD = CW x	NA	NA	4.93E-01

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Dermal Noncancer

$$ADD = \frac{DAev \times SA \times EvF \times EF \times ED \times CF}{BW \times ATnc \times GIABS}$$

Dermal Cancer -Adj

$$LADD = \frac{DAev \times DFW \times CF}{ATc \times GIABS}$$

Dermal Cancer - Mutagenic

$$\frac{DAevt \times DFWm \times CF}{ATc \times GIABS}$$

	Child	Adult	Resident-Adj
Noncancer ADD = DAev / GIABS x	4.07E-01	1.16E-01	NA
Cancer LADD = DAev / GIABS x	NA	NA	7.78E-02
Mutagenic Cancer LADD = DAev / GIABS x	NA	NA	2.52E-01

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

$$IFW = \frac{EFc \times EDc \times IRWc}{BWc} + \frac{Efa \times Eda \times IRWa}{Bwa}$$

$$DFW\ (ev\text{-}cm2/kg) = \frac{EFc \times EVc \times EDc \times SAc}{BWc} + \frac{EFa \times EVa \times EDa \times SAa}{Bwa}$$

$$t_{event\text{-}adj} = \frac{t_{event\text{-}c} \times EDc + t_{event\text{-}a} * EDa}{EDc + EDa}$$

Table C-5B. Receptor Exposure Factors and Intake Equations - Groundwater Hypothetical Residents (CTE)

Parameter	Symbol	(units)	Hypothetical Child Resident	Hypothetical Adult Resident	Hypothetical Resident-Adjusted	Source
Concentration in GW	CW (i.e., EPC)	(µg/L)	chem-specific	chem-specific	chem-specific	n/a
DA event	DA_event	(µg/cm^2-ev)	chem-specific	chem-specific	chem-specific	n/a
GI Tract Absorption	GIABS	(unitless)	chem-specific	chem-specific	chem-specific	n/a
Andleman Vol Factor	K	(L/m^3)	0.5	0.5	0.5	RSL
Body Weight	BW	(kg)	15	80	n/a	RSL
Event Frequency	EvF	(events/day)	1	1	1	RSL
Exposure Frequency	EF	(days/year)	350	350	350	OU3
Exposure Duration	ED	(years)	2	9	9	OU3
Exposure Time	ET	(hr/day)	24	24	24	RSL
Exposure Time GW	ETev	(hr/event)	0.33	0.25	n/a	RAGSE
Exposure Time Dermal/Water - Age-adjusted	tevent-adj	(hr/event)	n/a	n/a	0.26	RSL eqn
Water Ingestion Rate - Age-adjusted	IFW	(L/kg)	n/a	n/a	68	RSL eqn
Water Ingestion Rate - Mutagenic	IFWm	(L/kg)	n/a	n/a	546	RSL eqn
Water dermal contact factor - Age-adjusted	DFW	(cm2-ev/kg)	n/a	n/a	677081	RSL eqn
Water dermal contact factor - Mutagenic	DFWm	(cm2-ev/kg)	n/a	n/a	6441633	RSL eqn
Inhalation Mutagenic Exposure	EXm	(days)	n/a	n/a	25200	RSL eqn
Conversion Factor	CF	(mg/ug)	1.00E-03	1.00E-03	1.00E-03	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.0417	0.0417	0.0417	n/a
Water Ingestion Rate	IR_w	(L/dy)	0.45	1.2	n/a	EFH
Skin Surface Area	SA	(cm^2)	6,365	9,652	n/a	RSL
Avg Time (non-cancer)	AT nc	(d)	730	3285	n/a	RSL
Avg Time (cancer)	AT c	(d)	25550	25550	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

EFH: Exposure Factors Handbook (EPA, 2011)

a) Weighted mean of consumer-only ingestion of drinking water (Table 3-1)

b) Average residential occupancy period (Table 16-5). Assume 3 as a child and 9 as an adult.

RAGSE: Risk Assessment Guidance for Superfund: Part E (EPA, 2004)

n/a: Not applicable

Ingestion Noncancer

$$ADD = \frac{CW \times IR \times CF \times EF \times ED \times RBA}{BW \times ATnc}$$

Ingestion Cancer -Adj

$$LADD = \frac{Cw \times IFW \times CF \times RBA}{Atc}$$

Ingestion Cancer - Mutagenic

$$\frac{Cw \times IFWm \times CF \times RBA}{Atc}$$

	Child	Adult	Resident-Adj
Noncancer ADD = CW x RBA x	2.88E-05	1.44E-05	NA
Cancer LADD = CW x RBA x	NA	NA	2.67E-06
Mutagenic Cancer LADD = CW x RBA x	NA	NA	2.14E-05

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Inhalation Noncancer

$$ADD = \frac{CW \times K \times ET \times CF\_Inh \times CF \times EF \times ED}{ATnc \times RfC}$$

Inhalation Cancer - Adj

$$LADD = \frac{CW \times K \times ET \times CF\_Inh \times EF \times (ED)}{ATc}$$

Inhalation Cancer - Mutagenic

$$\frac{CW \times K \times Exm}{ATc}$$

$EXm = \sum (ET \times EF \times ED \times CF\_Inh \times Factor)$

	Child	Adult	Resident-Adj
Noncancer ADD = CW x	4.79E-04	4.79E-04	NA
Cancer LADD = CW x	NA	NA	6.16E-02
Mutagenic Cancer LADD = CW x	NA	NA	4.93E-01

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

Dermal Noncancer

$$ADD = \frac{DAev \times SA \times EvF \times EF \times ED \times CF}{BW \times ATnc \times GIABS}$$

Dermal Cancer -Adj

$$LADD = \frac{DAev \times DFW \times CF}{ATc \times GIABS}$$

Dermal Cancer - Mutagenic

$$\frac{DAevt \times DFWm \times CF}{ATc \times GIABS}$$

	Child	Adult	Resident-Adj
Noncancer ADD = DAev / GIABS x	4.07E-01	1.16E-01	NA
Cancer LADD = DAev / GIABS x	NA	NA	2.65E-02
Mutagenic Cancer LADD = DAev / GIABS x	NA	NA	2.52E-01

Note: EPA RSL equations for TCE and vinyl chloride will be used if COPCs

$$IFW = \frac{EFc \times EDc \times IRWc}{BWc} + \frac{Efa \times Eda \times IRWa}{Bwa}$$

$$DFW\ (ev\text{-}cm2/kg) = \frac{EFc \times EVc \times EDc \times SAc}{BWc} + \frac{EFa \times EVa \times EDa \times SAa}{Bwa}$$

$$t_{event\text{-}adj} = \frac{t_{event\text{-}c} \times EDc + t_{event\text{-}a} * EDa}{EDc + EDa}$$

Table C-6A. Receptor Exposure Factors and Intake Equations - Excavation Worker - Trench Vapors (RME)

Parameter	Symbol	(units)	Excavation Worker	Source
Concentration in Air in Trench	Ct	($\mu g/m^3$)	chem-specific; eqn below	n/a
Concentration in Groundwater	CW	($\mu g/L$)	chem-specific	n/a
Volitilization Factor	VF	(L/m^3)	chem-specific; eqn below	n/a
Trench Length	TL	(m)	2.44	VADEQ
Trench Depth	TD	(m)	1.524	OU3 (5 ft)
Trench Width	TW	(m)	0.91	VADEQ
Trench Area (L x W)	A	(m^2)	2.2204	n/a
Trench Volume (L x W x D)	TV	(m^3)	3.38	n/a
Trench Fraction of Floor for Entry	F	n/a	1	VADEQ
Trench Air Changes per Hour	ACH	(h^{-1})	2	VADEQ
Ideal Gas Constant	R	($atm\text{-}m^3/mol\text{-}K$)	8.2E-05	VADEQ
Average System Absolute Temperature	T	(K)	298	VADEQ
Henry's Law Constant	Hi	($atm\text{-}m^3/mol$)	chem-specific	n/a
Molecular Weight of H2O	MW_{H2O}	(g/mol)	18	VADEQ
Molecular Weight of O2	MW_{O2}	(g/mol)	32	VADEQ
Molecular Weight of Constituent	MWi	(g/mol)	chem-specific	n/a
Liquid-phase Mass Transfer Coefficient of Oxygen	k_{LO2}	(cm/s)	0.002	VADEQ
Gas-phase Mass Transfer Coefficient of Oxygen	k_{GO2}	(cm/s)	0.8333	VADEQ
Exposure Duration	ED	(yrs)	1	RSL
Exposure Frequency	EF	(days/year)	260	OU3
Exposure Frequency Trench = 20% x EF	EFt	(days/year)	130	prof judg
Weeks Worked	EW	(weeks/yr)	26	OU3
Exposure Time	ET	(hr/day)	8	RSL
Exposure Time Trench = 1/2 ET	ETt	(hr/day)	4	VADEQ
Conversion Factor	CF	(mg/ug)	1.00E-03	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.0417	n/a
Averaging Time Noncancer = EW x 7 x ED	ATnc	(days)	182	RSL
Avg Time (cancer)	AT c	(d)	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

VADEQ: Virginia Unified Risk Assessment Model - VURAM User Guide (VADEQ, 2018)

Note: Risks to Industrial Workers and Residents will be calculated using the VISL calculator and the above site-specific exposure factors utilized for other media.

$$ADD = \frac{Ct \times ETt \times CF\_Inh \times CF \times EFt \times ED}{Atnc} \qquad LADD = \frac{Ct \times ETt \times CF\_Inh \times EFt \times ED}{ATc}$$

Noncancer ADD = Ct x 1.19E-04

Cancer LADD = Ct x 8.48E-04

Ctrench = CW x VF

Due to shallow groundwater table (less than 15ft), assume groundwater pooling in the trench (VADEQ)

VF (Equation 2-4 from VADEQ)

$$VF = \frac{(Ki \times A \times F \times 10^{-3}\ L/cm^3 \times 10^4\ cm^2/m^2 \times 3600\ s/hr)}{ACH \times V}$$

$$Ki = \frac{1}{[(1/k_{iL}) + [(R*T)/(Hi * k_{iG})]]}$$ Overall Mass Transfer Coefficient (cm/s)

$k_{iL} = MW_{O2}/MWi)^{0.5} * (T/298) * K_{LO2}$ Liquid-phase Mass Transfer Coefficient (cm/s)

$k_{iG} = (MW_{H2O}/MWi)^{0.335} * (T/298)^{1.005} \times K_{gH2O}$ Gas-phase Mass Transfer Coefficient (cm/s)

Table C-6B. Receptor Exposure Factors and Intake Equations - Excavation Worker - Trench Vapors (CTE)

Parameter	Symbol	(units)	Excavation Worker	Source
Concentration in Air in Trench	Ct	($\mu g/m^3$)	chem-specific; eqn below	n/a
Concentration in Groundwater	CW	($\mu g/L$)	chem-specific	n/a
Volitilization Factor	VF	(L/m^3)	chem-specific; eqn below	n/a
Trench Length	TL	(m)	2.44	VADEQ
Trench Depth	TD	(m)	1.524	OU3 (5 ft)
Trench Width	TW	(m)	0.91	VADEQ
Trench Area (L x W)	A	(m^2)	2.2204	n/a
Trench Volume (L x W x D)	TV	(m^3)	3.38	n/a
Trench Fraction of Floor for Entry	F	n/a	1	VADEQ
Trench Air Changes per Hour	ACH	(h^{-1})	2	VADEQ
Ideal Gas Constant	R	(atm-m^3/mol-K)	8.2E-05	VADEQ
Average System Absolute Temperature	T	(K)	298	VADEQ
Henry's Law Constant	Hi	(atm-m^3/mol)	chem-specific	n/a
Molecular Weight of H2O	MW_{H2O}	(g/mol)	18	VADEQ
Molecular Weight of O2	MW_{O2}	(g/mol)	32	VADEQ
Molecular Weight of Constituent	MWi	(g/mol)	chem-specific	n/a
Liquid-phase Mass Transfer Coefficient of Oxygen	k_{LO2}	(cm/s)	0.002	VADEQ
Gas-phase Mass Transfer Coefficient of Oxygen	k_{GO2}	(cm/s)	0.8333	VADEQ
Exposure Duration	ED	(yrs)	1	RSL
Exposure Frequency	EF	(days/year)	260	OU3
Exposure Frequency Trench = 20% x EF	EFt	(days/year)	130	prof judg
Weeks Worked	EW	(weeks/yr)	12	OU3
Exposure Time	ET	(hr/day)	8	RSL
Exposure Time Trench = 1/2 ET	ETt	(hr/day)	4	VADEQ
Conversion Factor	CF	(mg/ug)	1.00E-03	n/a
Conversion Factor Inh	CF_Inh	(dy/hr)	0.0417	n/a
Averaging Time Noncancer = EW x 7 x ED	ATnc	(days)	84	RSL
Avg Time (cancer)	AT c	(d)	25550	RSL

OU3: Value used in OU3 HHBRA (EPS, 2012)

RSL: EPA's Regional Screening Levels (RSLs) - User's Guide (Nov 2020)

VADEQ: Virginia Unified Risk Assessment Model - VURAM User Guide (VADEQ, 2018)

Note: Risks to Industrial Workers and Residents will be calculated using the VISL calculator and the above site-specific exposure factors utilized for other media.

$$ADD= \frac{Ct \times ETt \times CF\_Inh \times CF \times EFt \times ED}{Atnc} \qquad LADD= \frac{Ct \times ETt \times CF\_Inh \times EFt \times ED}{ATc}$$

Noncancer ADD = Ct x 2.58E-04

Cancer LADD = Ct x 8.48E-04

Ctrench = CW x VF

Due to shallow groundwater table (less than 15ft), assume groundwater pooling in the trench (VADEQ)

VF (Equation 2-4 from VADEQ)

$$VF = \frac{(Ki \times A \times F \times 10^{-3}\ L/cm^3 \times 10^4\ cm^2/m^2 \times 3600\ s/hr)}{ACH \times V}$$

$$Ki = \frac{1}{[(1/k_{iL}) + [(R^*T)/(Hi * k_{iG})]]}$$ Overall Mass Transfer Coefficient (cm/s)

$k_{iL} = MW_{O2}/MWi)^{0.5} * (T/298) * K_{LO2}$ Liquid-phase Mass Transfer Coefficient (cm/s)

$k_{iG} = (MW_{H2O}/MWi)^{0.335} * (T/298)^{1.005} \times K_{gH2O}$ Gas-phase Mass Transfer Coefficient (cm/s)

Attachment D
Groundwater Risk Plume Cores

ATTACHMENT D
GROUNDWATER PLUME CORES

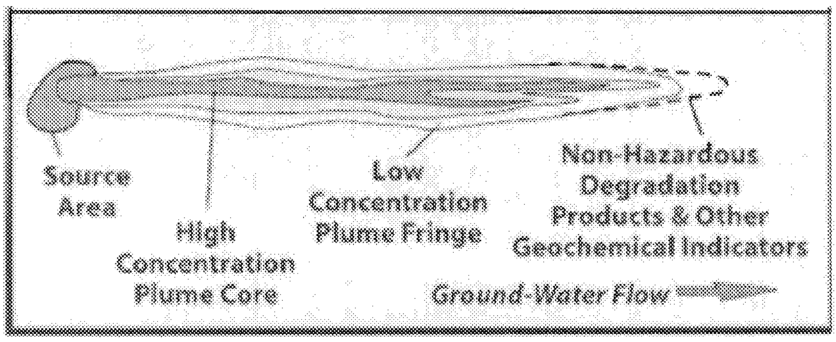
Introduction

This attachment provides the background information and methodology applied to select representative data (*i.e.,* well locations) to calculate groundwater exposure point concentrations ("EPC"). The methodology, which builds upon the objective of OSWER Directive 9283.1-42, *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (the "Directive"), selects representative data for use in EPC development based on a cumulative risk-based assessment process founded on the groundwater conceptual site model ("CSM") and two Directive data objectives:

- EPC input data are representative of the plume core (*i.e.,* 3-D spatial data consideration); and
- EPC input data are representative of the current Site condition (*i.e.,* temporal data consideration).

The plume core is defined in Directive as the zone of the highest concentration of each contaminant within a delineated groundwater plume. Conceptually the plume core is detailed in the Directive as the groundwater region extending from a contaminant source area to the low concentration plume fringe. Thus, the plume core is representative of the full breadth of the high concentration plume profile.

Inset 1: Idealized plan view of groundwater contaminant plume for purpose of distinguishing the "core" from the fringe areas (OSWER Directive 9281.1-42).



The second data objective, that the EPC development data is representative of current site conditions, ensures the EPC appropriately characterizes the site to support risk management decisions on a reasonable maximum exposure ("RME") basis. The Directive recognizes, subject to the CSM, the data period representative of a site's current condition may be more or less than one year and the selection of the data period is determined by site-specific temporal factors. Sites with seasonable or other temporal influences require more recent data (*i.e.,* approximately one year) whereas sites with stable concentration profiles maybe longer. The Directive does not establish a limit on the temporal period, nor does the Directive impose limits on allowing separate temporal evaluations based on different contaminants, areas, or plumes on a given site.

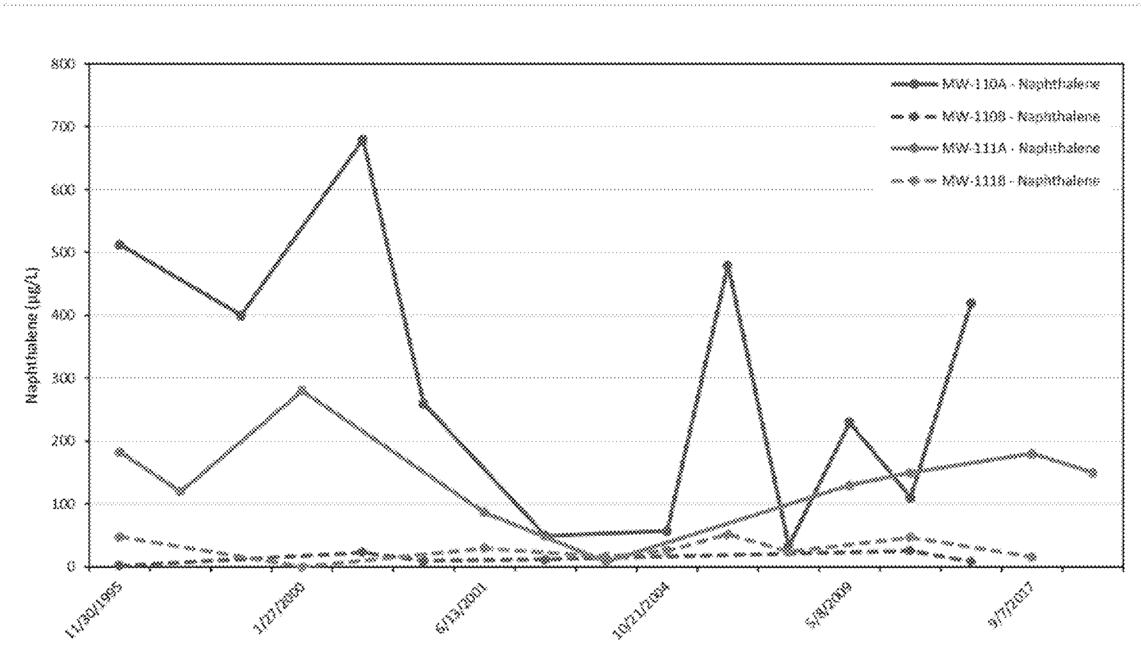
The remainder of this attachment provides a summary of the data considerations and methodology applied to compile a representative set of well locations for EPC development. Since a fundamental element of the Directive is centering decisions on the CSM, a summary of the groundwater CSM is described to reinforce Site-specific spatial and temporal elements. The balance of the attachment provides the risk-based methodology, identification of representative groundwater areas for EPC development, and a list of well locations from which data will be extracted for EPC calculation.

Site Background: Summary of Groundwater CSM

Industrial development of the LCP Site began approximately 100 years ago in 1919 and continued until 1994. The Site features and infrastructure that evolved over this period to support each successive industrial activity overlap. Associated with each historical operation were numerous processes that generated various waste material or liquids that, in some instances, were released to the surface or groundwater thus resulting in the diverse Sitewide groundwater condition. A brief overview of the operations and their contribution to the groundwater condition are summarized here and illustrated in Figure D-1.

Starting in 1919, Arco operated the Site as a petroleum refinery until the early 1930s. At one time, over 100 process and storage tanks were present on the Arco facility with operations spanning much of the Site. Petroleum process sludges were buried in the portions of the former Brunswick-Altamaha Canal, which traversed the western margin of the Site. As a result, much of the Site is characterized by a highly-weathered petroleum 'smear zone', a residual petroleum product that is entrained in the soil matrix and spread (smeared) vertically across the range of the groundwater table fluctuation on the Site. This serves as the source for volatile organic compounds ("VOCs") and polycyclic aromatic hydrocarbons ("PAHs") in the groundwater and is observed in the groundwater data as a fluctuating condition that is more pronounced in the shallow A series wells (see example below, Inset 2).

Inset 2: Illustration of fluctuating/variable Naphthalene concentration in shallow groundwater in comparison to the more stable and lower concentration condition in deeper groundwater (i.e., below the petroleum smear zone).



In 1955 Allied Chemical and Dye Corporation established and operated a chlor-alkali facility that replaced much of the refinery infrastructure. Sodium hydroxide or caustic was the primary chemical product of the chlor-alkali facility and was produced with the mercury-cell process. Historical release of mercury is attributed to the loss of liquid mercury during system operation (*i.e.*, leaks and spills) beneath the former cell building area ("CBA") and to a lesser extent as dissolved mercury in caustic releases and other process waste slurries impounded at locations across the Site. Caustic releases collocated with brine releases and from various Site impoundments also occurred and created a highly altered geochemical state in the groundwater that greatly enhanced metals solubility.

Additional Site operations that contributed to the groundwater condition include a power generation plant and coatings manufacturing. The power generation plant operated in the mid-1900s and was supported by Bunker C oil. Extensive cleanup of soil in the former Bunker C tank farm was completed during the 1994-96 soil removal action. In the 1940s and 1950s, a paint and varnish manufacturing facility operated on a portion of the Site. On-Site disposal of these coatings products was concluded from the nature of the soil and waste removed from the Former Facility Disposal Area at the western upland boundary of the Site.

The resultant Sitewide groundwater condition from these past operations include several metals (arsenic, beryllium, chromium, lead, mercury, selenium, vanadium), VOCs, and PAHs that are comingled due to the historical overlap of Site operations. The origin of the groundwater contaminants can generally be attributed to releases associated with one or more of past industrial operations and process-related activities; however, some metal groundwater constituents are attributed to secondary effects caused by the past release of caustic that modified the local geochemistry and subsequently mobilized or facilitated metals solubility from the native mineralogy. This altered geochemical condition was labeled the caustic brine pool ("CBP") and was the focus of a Removal Response Action from 2013-2019, utilizing sparging of carbon dioxide ("CO_2") gas into the Satilla Formation to facilitate neutralization of the high pH condition associated with the CBP. This treatment has resulted in a recent decrease in the concentration of some of the metals in groundwater most notably mercury. However, a trending feature of the Site groundwater condition, including before the CO_2 sparing treatment, is a generally stable condition that was experiencing a degree of chemical attenuation (*e.g.,* degradation, adsorption, precipitation) based on overall declining concentration trends from around 2006 to 2012 which was then further accelerated by the CO_2 treatment.

Risk-Based Plume Evaluation

The Directive data concepts and CSM-focused decision framework form the basis for our approach for identifying well locations to support EPC development. The CSM for LCP illustrates a Site with a complex and geographically-diverse groundwater COC condition that does not lend itself to the simple concept of a 'plume core' due to the spatially diverse and comingled nature of the Sitewide condition. Thus, we provide an informed risk-based approach to identify groundwater plume cores based on a cumulative point risk analysis, from which a group of wells is identified to quantify the EPC. The cumulative point risk analysis is a direct surrogate for constituent concentration, thus maintaining consistency with the Directive objectives, as the risk and hazard are a function of the constituent concentration but provide an informed profile of the overall groundwater condition to focus the human health risk assessment to areas of greatest potential risk.

For this evaluation the base dataset used included the data collected from the Site-wide sampling event in 2017 through 2020. From this dataset, we captured the most recent sampling result for each constituent from each location. For locations where there were multiple wells screened at different depths in the aquifer, the highest concentration for each constituent was used.

Within the temporal data constraints, the cumulative point (well) risk analysis was completed to identify the area (separate assessments were completed for the Satilla Fm and Ebenezer Fm zones) posing the highest risk. The analysis of groundwater cumulative point risk was completed with the *Spatial Analysis and Decision Assistance* ("SADA") software package[1]. SADA applies the EPA's Risk Assessment Guidance for Superfund ("RAGS") and can be operated to fit specific land-use scenarios, exposure pathways, and toxicological factors. The results of the SADA-based point risk are provided for non-cancer hazard and carcinogenic risk in Figures D-2 and D-3, respectively. Within each figure, chemical groups are illustrated with common color hues to help differentiate the primary drivers of risk or hazard (red/purple hues = metals, green hues = VOCs, and brown hues = PAHs).

[1] *Spatial Analysis and Decision Assistance, Version 5.0,* University of Tennessee Research Corporation and Oak Ridge National Laboratory.

Based on the point risk data, three risk-based plume cores were determined with two plume cores in the Satilla Fm (the North and South plume cores) and one plume core in the Ebenezer Fm, each with distinct carcinogenic risk and non-carcinogenic hazard profiles. A general overview of the plume profiles is provided below.

Non-Cancer Hazard Groundwater Profiles

The North Satilla Plume Core exhibits the Site's maximum non-carcinogenic hazard with a PAH-driven risk-based condition. The primary PAHs contributions to the non-cancer hazard are naphthalene and 1,2,4-trimethylbenzene. The spatial focus of the PAHs corresponds to the former barge canal where petroleum sludges were disposed of as summarized in the CSM. South of B Street and west of the former CBA is the second distinct risk-based condition in the Satilla – the South Satilla Plume Core. The primary constituents that drive the non-cancer hazard profile in this area include a comingled mix of metals (arsenic, vanadium, and mercury)[2] with a lesser contribution to the non-cancer hazard from PAHs and VOCs. In the Ebenezer Fm., physical attenuation of groundwater constituents by the variably cemented sandstone is observed by the lesser overall non-cancer hazard. The non-cancer hazard in the Ebenezer Fm. is driven by three metal constituents: arsenic, mercury, and vanadium.

Cancer Risk Groundwater Profile

Similar to the non-cancer hazard profile, the North Plume Core exhibits a substantial risk contribution from PAHs with arsenic, benzene, and ethylbenzene being additional contributors to cancer risk. In the South Plume Core, the relative profile of constituents contributing to carcinogenic risk is consistent with the northern half of the Site but the relative contribution to the risk flips with arsenic recognized as the primary driver and PAHs as the lesser factor in overall cancer risk. A notable contribution from 1,4-dichlorobenzene is also observed in the South Plume Core. In the Ebenezer Plume Core, the carcinogenic risk is driven generally by arsenic as other groundwater carcinogenic constituents occur primarily in the shallow portion of the Satilla Fm. or are physically attenuated by the variably cemented sandstone. Whereas the Directive's use of the term attenuation describes temporal changes in a contaminant concentration due to degradation, our use of the term reflects the physical attenuation of contaminant transport from the Satilla Fm to the Ebenezer Fm (*i.e.,* physical vs chemical attenuation).

Summary of Wells for EPC Development

The approximate bounds of the three risk-based plume cores were used to select well locations from which groundwater data will be extracted for EPC development. A summary of the well locations is provided below, which are all wells (including those screened at different intervals at a given location) within each plume core. This is appropriate because if a supply well were

[2] In 2019, thallium was reported at 8.8 μg/L in MW-355B after only one detection (at 0.07 μg/L) since 1996 (11 samples). Since there is no known release of thallium or reasonable explanation for the apparent detection the value the result is not considered representative of area groundwater and MW-355B is not retained in the risk-based plume well set.

installed, it would extract water from a wide area both laterally and vertically. By excluding wells outside each plume core, this provides a reasonable maximum concentration.

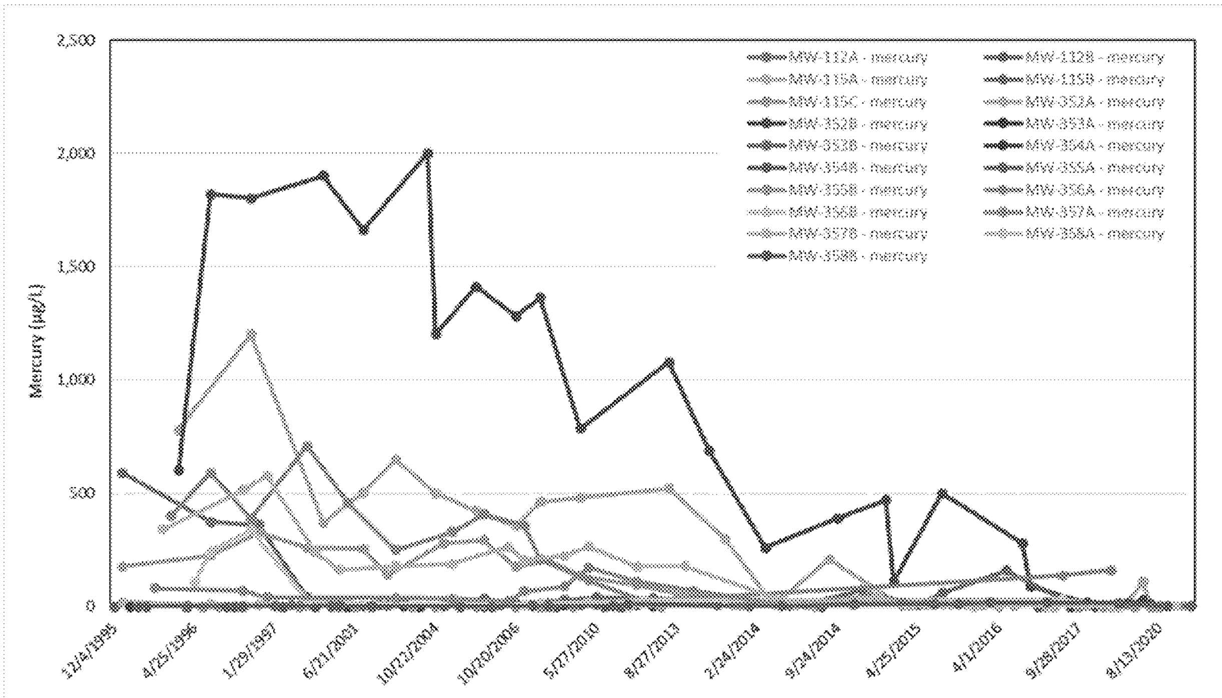
Inset 3: Well Locations for EPC Development A/B

North Satilla Plume Core	South Satilla Plume Core			Ebenezer Plume Core
MW-110A/B/C	MW-104B/C	MW-362A/B	MW-510A/B	HWEast4
MW-111A/B/C	MW-105A/B/C	MW-501A/B	MW-511A/B	HWEast5
MW-301A/B	MW-112A/B/C	MW-502A/B	MW-512A/B	HWWest2
MW-302	MW-115A/B/C	MW-503A/B	MW-513A/B	HWWest3
MW-303	MW-352A/B	MW-504A/B	MW-514A/B	HWWest4
MW-308	MW-353A/B	MW-505A/B	MW-515A/B	MW-115E
MW-309	MW-354A/B	MW-506A/B	MW-516A/B	MW-360D
MW-310A/B	MW-356A/B	MW-507A/B	MW-517A/B	
MW-311A/B	MW-357A/B	MW-508A/B	MW-518A/B	
	MW-358A/B	MW-509A/B	MW-519A/B	

Temporal Data Use

The Directive acknowledges the data period representative of current Site conditions needs to consider Site-specific temporal factors. For the LCP Site, the CSM and data trends indicate different temporal data limits need consideration subject to recent Site activity and hydrogeologic zones. In the South Satilla Plume, the CO_2 sparging treatment has substantially altered the groundwater chemistry and reduced certain metal concentrations necessitating a focus on more recent testing results. Groundwater results for aqueous mercury from a series of monitoring wells in the southern Satilla Fm illustrate the recent precipitous decline in mercury concentration. Thus, data usage for the South Satilla Plume Core will be limited to the recent 2020 testing.

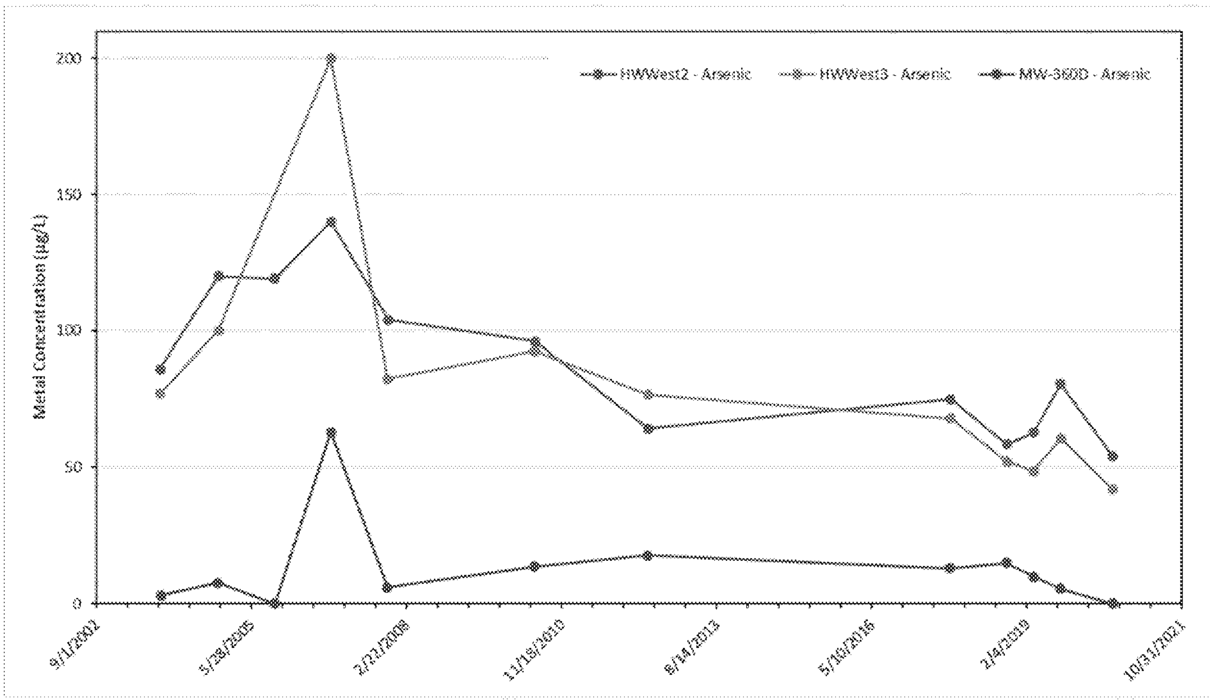
Inset 4: Historical trend for groundwater mercury in CO_2 sparging treatment zone.



Groundwater data collected from the North Satilla Plume supports a broader temporal dataset reinforced by the age of the historical release and overall contaminant stability in terms of migration. Thus, for EPC development, we will apply an aggregated dataset that captures data collected from the Site-wide sampling event in 2017 through 2020.

In the Ebenezer Plume Core, the 2017 to 2020 dataset will also be applied as the period dataset captures recent 2020 testing for wells considered most susceptible to changes resulting from the CO_2 sparing treatment and wells at more distant locations that exhibit little change over the Site's recent monitoring history. The trend for arsenic (the primary driver of cancer risk in the Ebenezer Fm) from locations HWWest2, HWWest3, and MW-360D are provided below to illustrate the representativeness of the current condition with respect to the past.

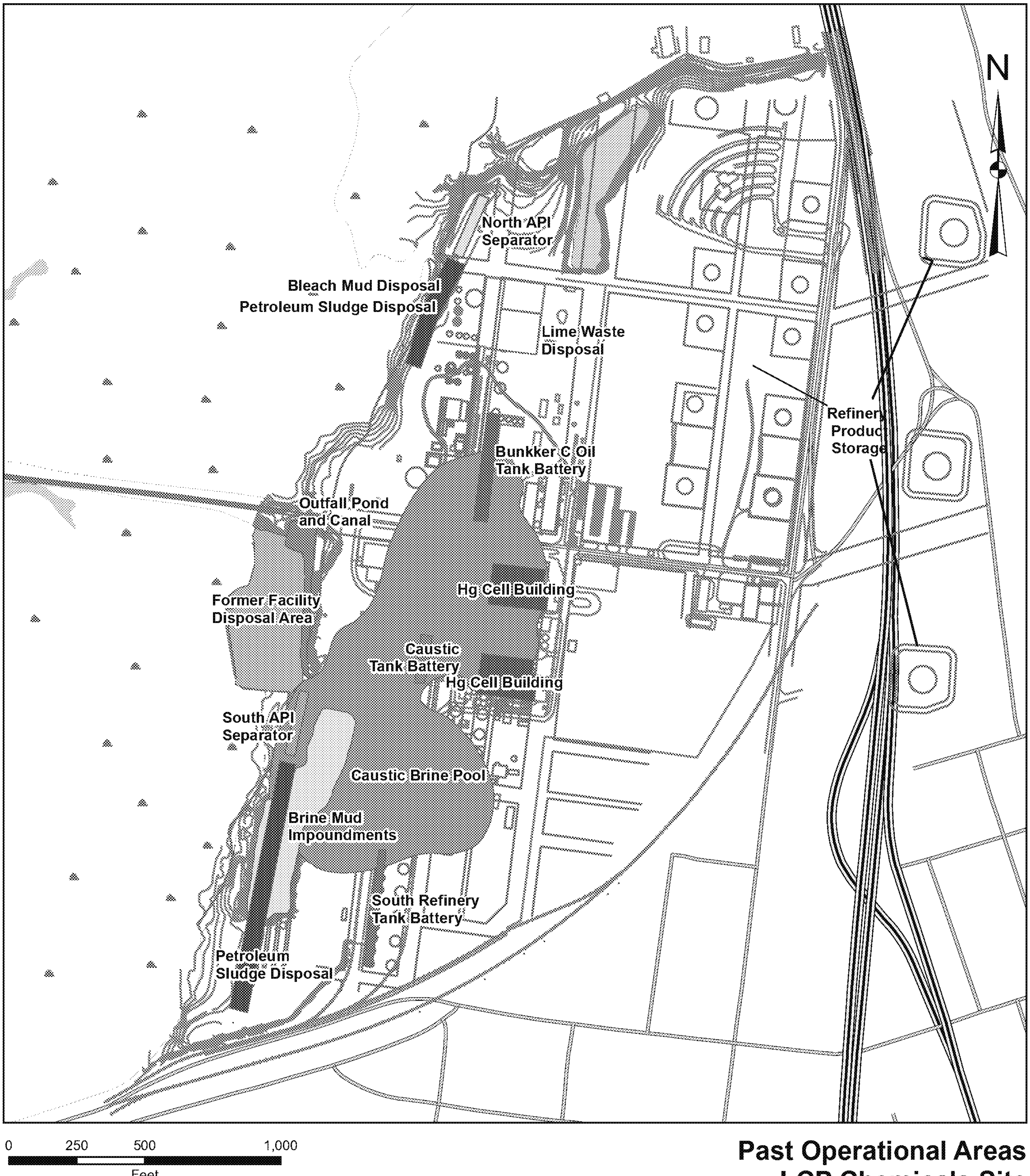
Inset 5: Illustration of arsenic stability in the Ebenezer Fm.



In summary, applying the spatial and temporal constraints described above, the wells and dates sampled to be used for EPC determination will the datasets described in Inset 6.

Inset 6: Datasets for EPC determination.

North Satilla Plume Core		South Satilla Plume Core		Ebenezer Plume Core	
Well	Date Sampled	Well	Date Sampled	Well	Date Sampled
MW-110A	9/6/2017	MW-112B	8/13/2020	HWEast4	9/27/2017
MW-110B	9/6/2017	MW-112C	8/14/2020	HWEast4	9/28/2018
MW-110C	9/6/2017	MW-115A	8/17/2020	HWEast4	3/21/2019
MW-111A	9/7/2017	MW-353B	8/13/2020	HWEast4	9/13/2019
MW-111A	8/13/2020	MW-353B	8/15/2020	HWEast4	8/12/2020
MW-111B	9/7/2017	MW-356B	8/14/2020	HWEast5	9/27/2017
MW-111C	9/7/2017	MW-357A	8/13/2020	HWEast5	9/28/2018
MW-301A	10/3/2017	MW-358B	8/13/2020	HWEast5	3/21/2019
MW-301A	10/23/2017	MW-362A	8/14/2020	HWEast5	9/13/2019
MW-301B	10/3/2017	MW-362B	8/14/2020	HWEast5	8/12/2020
MW-301B	10/23/2017	MW-503B	8/13/2020	HWWest2	9/30/2017
MW-301B	8/14/2020	MW-504A	8/13/2020	HWWest2	9/27/2018
MW-302	9/28/2017	MW-505A	8/13/2020	HWWest2	3/20/2019
MW-303	9/29/2017	MW-506A	8/14/2020	HWWest2	9/10/2019
MW-308	9/28/2017	MW-506B	8/14/2020	HWWest2	8/11/2020
MW-309	9/29/2017	MW-507A	8/14/2020	HWWest3	9/30/2017
MW-310A	9/28/2017	MW-507B	8/14/2020	HWWest3	9/27/2018
MW-310B	9/28/2017	MW-509B	8/17/2020	HWWest3	3/20/2019
MW-311A	9/29/2017	MW-510A	8/17/2020	HWWest3	9/11/2019
MW-311B	9/29/2017	MW-512B	8/17/2020	HWWest3	8/11/2020
		MW-513A	8/14/2020	HWWest4	9/30/2017
		MW-513B	8/14/2020	HWWest4	9/27/2018
		MW-515B	8/17/2020	HWWest4	3/20/2019
		MW-516A	8/14/2020	HWWest4	9/10/2019
		MW-516B	8/14/2020	HWWest4	8/11/2020
		MW-517A	8/14/2020	MW-115D	9/23/2017
		MW-517B	8/14/2020	MW-115D	9/23/2018
				MW-115D	3/20/2019
				MW-115D	9/10/2019
				MW-115D	8/11/2020
				MW-360D	9/25/2017
				MW-360D	9/23/2018
				MW-360D	3/21/2019
				MW-360D	9/10/2019
				MW-360D	8/10/2020



Past Operational Areas
LCP Chemicals Site
Brunswick, GA

Land Features

Marsh

Upland

Water

MONTROSE ENVIRONMENTAL

Figure No.D-1

0 250 500 1,000
Feet

Land Features

Marsh

Upland

Water

Risk-based Plume Center

Arsenic
Beryllium
Chromium
Mercury
Selenium
Vanadium
Nickel
Thallium
Benzene
Ethyl Benzene
Chlorobenzene
124-Trimethylbenzene
124-Trichlorobenzene
Methylene Chloride
14-Dichlorobenzene
Naphthalene
1-Methylnaphthalene
2-Methylnaphthalene

Point Non-Cancer Hazard Analysis:
LCP Chemicals Site
Brunswick, GA

Note: Symbol size is proportional to Non-Cancer Hazard within each respective Formation only and have been adjusted to provide easy visual comparison between data points.

MONTROSE ENVIRONMENTAL

Figure No.D-2

0 250 500 1,000
Feet

Land Features

Marsh

Upland

Water

Risk-based Plume Center

Arsenic

Benzene

Ethyl Benzene

124-Trichlorobenzene

Methylene Chloride

14-Dichlorobenzene

Naphthalene

1-Methylnaphthalene

Benzo(a)anthracene

Benzo(a)pyrene

Note: Symbol size is proportional to Cancer Risk within each respective Formation only and have been adjusted to provide easy visual comparison between data points.

Point Cancer Risk Analysis: LCP Chemicals Site Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No.D-3